NAOMS

Reference Report

Concepts, Methods, and Development Roadmap

Prepared by Battelle Memorial Institute for
NASA Ames Research Center

Contract NNA05AC07C

November 30, 2007

Battelle
The Business of Innovation

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Acronyms and Abbreviations

AC Survey	Air Carrier Survey (NAOMS)
ADF	Automatic Direction Finder
AFA	Association of Flight Attendants
AFL-CIO	American Federation of Labor-Congress of Industrial Organizations
AIDS	Accident/Incident Data System (FAA)
ALPA	Air Line Pilots Association
AOA	Angle of Attack
AOPA	Aircraft Owners and Pilots Association
ASIST	Aviation Safety Investment Strategy Team
ASMM	Aviation System Modeling and Monitoring (component of AvSP)
ASRS	Aviation Safety Reporting System
ATC	Air Traffic Control
ATIS	Air Terminal Information System
ATP	Air Transport Pilot
AvSP	Aviation Safety Program (NASA) (succeeded by AvSSP)
AvSPEC	Aviation Specialty Corporation
AvSSP	Aviation Safety and Security Program (NASA)
BTS	U.S. Bureau of Transportation Statistics
CAPI	Computer-Assisted Personal Interview
CASI	Computer-Assisted Self Interview
CAST	Commercial Aviation Safety Team
CATI	Computer-Assisted Telephone Interview
CFI	Certified Flight Instructor
CFIT	Controlled Flight into Terrain
CFTT	Controlled Flight Toward Terrain
COTS	Commercial Off the Shelf
CPHRE	Centers for Public Health Research and Evaluation (Battelle)
CRM	Cockpit Resource Management
DNFA	Distributed National FOQA Archive
DOT	Department of Transportation
ETOPS	Extended Twin (Engine) Operations
F/O	First Officer
FAA	Federal Aviation Administration
FADEC	Full Authority Digital Engine Control
FL	Flight Level
FOQA	Flight Operational Quality Assurance
GA	General Aviation
GA Survey	General Aviation Survey (NAOMS)
GAAAS	General Aviation Avionics and Activity Survey
GLM	General Linear Model
GPS	Global Positioning System
GPWS	Ground Proximity Warning System

HUD	Heads-Up Display
ICAC	In-Close Approach Changes
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
JIMDAT	Joint Implementation Measurement Data Analysis Team
LDA	Localizer (Type) Directional Aid
MEL	Minimum Equipment List
NAIMS	NTSB Aviation Accident/Incident Monitoring System
NAOMS	National Aviation Operations Monitoring Service
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NATCA	National Air Traffic Controllers Association
NBAA	National Business Aviation Association
NRC	National Research Council
NTSB	National Transportation Safety Board
OMB	Office of Management and Budget
PIC	Pilot in Command
RAA	Regional Airline Association
RRT	Randomized Response Technique
SAQ	Self-Administered Questionnaire
SDRS	Service Difficulty Reporting System
SID	Standard Instrument Departure
SME	Subject Matter Expert
STAR	Standard Arrival Route
TCAS	Traffic Collision Avoidance System
USPS	United States Postal Service
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional Range

1. Executive Summary

The National Aviation Monitoring Service (NAOMS) concept originated in 1997 in the Aviation Safety Investment Strategy Team (ASIST) planning workshops that led up to the launch of NASA's Aviation Safety Program (AvSP). This report summarizes the methodological development work that was done on the NAOMS project from 1998 to early 2007 by Battelle and its subcontractors under contract NNA05AC07C.

While the United States had many aviation safety data collection efforts, no program at that time provided decision-makers with statistically defensible estimates of the frequencies with which unwanted events occurred in the nation's airspace. Nor was it known with acceptable levels of certainty whether the frequencies of such occurrences were following upward or downward trends. Similarly, the national capacity to measure the effects of aviation safety interventions and to uncover unwanted side effects from those interventions was limited. NAOMS was built to help remedy these aviation safety measurement deficiencies by providing data that are statistically meaningful and representative of the safety trends occurring within the national airspace, thus allowing the aviation safety community to perform improved, data-driven analysis.

The NAOMS concept involved the use of carefully designed and executed surveys to solicit information from the operators of the aviation system – first, air carrier pilots, and then others, such as general aviation (GA) pilots. The information provided by these operator groups could be combined to provide a multifaceted picture of national aviation system safety in conjunction with other national aviation safety data sets. NAOMS surveys primarily asked participants about their experiences during flight operations as opposed to their opinions on aviation safety. Questions related to operational activity (risk exposure), unwanted events, and special topics, such as the effects of safety interventions.

During the late 1990s, the NAOMS team (NASA, Battelle, and its subcontractors) conducted a series of workshops to familiarize the aviation community with NAOMS and to engage its active participation in the program. Methodological research was then conducted about the nature and scope of questions that would be asked, the mode of survey data collection (self-administered, telephone-based, etc.), and other key issues. A NAOMS field trial in 2000 was followed by a successful program launch in 2001. Air carrier pilots were the first NAOMS respondent group. In 2002, GA pilots were included as respondents, but resource limitations caused the suspension of that data collection effort roughly 6 months after it was begun.

NAOMS achieved exceptional response rates from an enthusiastic aviation community, which was crucial to achieving high statistical validity. Almost 30,000 interviews had been conducted by the time data collection ended in December 2004. Working with the Commercial Aviation Safety Team (CAST) group also showed that NAOMS can be used to develop metrics for assessing the effectiveness of safety interventions.

In 2005 and 2006, the NAOMS data collection system was converted into a streamlined, web-based forum and transferred to the aviation industry for continuing operation.

2. Background

The National Aviation Monitoring Service (NAOMS) is a survey-based data collection system designed to collect aviation safety data from operational personnel, such as pilots, controllers, and mechanics. NAOMS was designed to quantify aviation safety events and other safety-relevant phenomena. These data can be used to identify system-wide trends and establish performance measures with emphasis on tracking the effects of safety interventions (new procedures, technologies, and training) on national aviation safety levels.

This report describes the evolution of NAOMS from its conception in 1997 through method development and later operational phases to the conclusion of data collection in December 2004, and its conveyance in a streamlined web form to the Air Line Pilots Association (ALPA) in 2007.

2.1. Gore Commission Report

In July 1996, the President of the United States established a special commission to evaluate the status of aviation safety and security in the United States. The White House Commission on Aviation Safety and Security, chaired by Vice President Al Gore, was asked to provide a comprehensive overview of the current state of aviation safety and to develop recommendations for measures to improve civil aviation safety and security, with respect to both domestic and international aviation.

In February 1997, the Commission issued a report calling for an 80 percent reduction in fatal accidents by the year 2007. The report also recommended that the National Aeronautics and Space Administration (NASA) provide its technical expertise to assist the aviation industry in achieving this goal.

NASA responded by creating the Aviation Safety Program (AvSP). NAOMS was designed to support the goals of AvSP's Aviation System Modeling and Monitoring (ASMM) component with particular emphasis on measuring the impacts of aviation safety enhancements growing out of AvSP and other initiatives.

2.2. Preexisting Sources of Aviation Safety Data

When NAOMS was launched in 1997, there were many preexisting valuable sources of aviation safety data; however, none of these sources provided the framework needed to accomplish the full spectrum of safety measurements NAOMS was designed to obtain.

Table 2-1 features a list of the aviation safety data resources, and their limitations, that existed at the time NAOMS was created in 1997.

Table 2-1. Major Sources of Aviation Safety Data in 1997 at the Time of NAOMS Conception

Data Set	Capabilities	Limitation
Air Traffic Control (ATC) radar tapes (These tapes record the flight trajectories of aircraft under ATC control.)	Captures data on aircraft trajectories in the national airspace.	Limited number of parameters. Not able to address human performance issues.
Air carrier digital flight (FOQA) data	Captures data on virtually every aspect of aircraft performance, movement, and equipment status.	Lacks information on operative ATC clearances, or more generally the intent of the pilots flying the aircraft. Makes it difficult to identify the many types of anomalies that involve deviations from clearances and related requirements. Few insights on human cognition or affect. Very few carriers had FOQA programs at the time of NAOMS inception.
NASA Aviation Safety Reporting System (ASRS)	Receives aviation safety reports from pilots, controllers, and other aviation operating personnel. Strong source of information on event dynamics, causation, and human performance.	Limited by self-reporting biases, which affect the statistical representativeness of the data, including the ability to trend incident frequencies. Does not *actively* collect data on topics of interest but functions instead in a passive mode.
Bureau of Transportation Statistics	Collects a substantial body of data on flight activity levels.	Does not collect information about unwanted aviation events.
General Aviation Avionics and Activity Survey (GAAAS)	Surveys a small percentage of aircraft owners that collect information on flight hours and legs, and related aspects of general aviation activity.	This survey is considered unrepresentative due to its low response rate.
National Airspace Information Monitoring System (NAIMS)	Collects incident data from a broad variety of FAA-incident and airman enforcement data systems.	NAIMS does not purport to have a complete or statistically representative sample of U.S. aviation safety incidents.
National Transportation Safety Board (NTSB) Aviation Accident/Incident Data System	Provides a considerable body of data on civilian aviation accidents and high-profile incidents.	Contains very little data on the majority of aviation safety incidents that occur annually.
Service Difficulty Reporting System (SDRS)	Provides a substantial body of data on aircraft and aircraft system equipment problems.	Only limited information about human operator performance (mechanics) in the context of equipment maintenance and repair. Thought to suffer from underreporting in a variety of areas.

While the data resources shown in Table 2-1 contain a great deal of valuable information, they tend to be limited by weak quantitative properties (unknown representative, low data set size, etc.) or are very limited in scope (can address only a narrow range of safety questions). The NAOMS survey methodology has the capacity to overcome these limitations by providing an active, broad spectrum, aviation safety data collection capability, with solid statistical properties.

3. The NAOMS Concept

Long-term surveys are a mainstay of government policymaking in areas such as economic activity, public health, and criminal justice. NAOMS was designed to provide a survey for aviation that employs the best practices of surveys used in other policy domains and provides comparable benefits. Accordingly, NAOMS involved the use of a comprehensive and methodologically robust survey process to obtain the following types of quantitative data:

- Level and composition of U.S. commercial and general aviation flight
- Frequency with which unwanted events occur in the national airspace
- Long-term trends in the frequencies of such unwanted events
- Effectiveness of aviation safety interventions and the occurrence of any unwanted side effects due to such interventions
- Other aviation operational and safety topics amenable to quantification and of interest to aviation policymakers and operators.

NAOMS was intended to have the methodological rigor to support aviation safety policy and investment decisions in conjunction with the many other data resources available to decision-makers. NASA and Battelle approached the development and operation of NAOMS with methodological thoroughness and probity as their foremost concern.

3.1. Tapping the Knowledge of System Operators

The key conviction underlying NAOMS design was that only the aviation systems operators – its pilots, air traffic controllers, mechanics, flight attendants, and others – have the situational awareness and breadth of understanding to measure and track the frequency of unwanted safety events and to provide insights on the dynamics of the safety events they observe. The challenge was to collect these data in a systematic and objective manner. A well-designed and implemented survey process can meet this requirement.

NAOMS surveys could potentially address a broad array of safety issues involving system design; human operator performance; organizational policies, procedures, and regulations; publications and charts; aircraft and ATC equipment; airspace structures, and other aspects of the aviation system.

While NAOMS surveys were administered only to air carrier and general aviation (GA) pilots, the NAOMS survey process could be extended to air traffic controllers, mechanics, flight attendants, and other system operators to obtain each group's unique aviation safety insights.

3.2 Data Reliability

NAOMS was an active data collection system that achieved rigor by acquiring data in a statistically controlled manner. All surveys are affected by self-selection bias, which results when prospective respondents can freely decide to "opt out." The effect of self-selection bias tends to diminish as the level of participation increases. As will be documented later in this report, roughly 90 percent of the eligible and successfully located NAOMS air carrier respondents agreed to participate in the NAOMS survey. This extraordinary level of participation enhances confidence in the reliability of NAOMS's data and attests to participants' interest in providing accurate survey responses.

The NAOMS air carrier survey also had a large sample size. Roughly 7,000 air carrier pilots were interviewed each year of NAOMS's operation from 2001 through 2004. This large sample size also serves to increase confidence in survey findings and extends the survey's ability to estimate the frequency of relatively rare safety events.

3.3. Emphasis on Experience Rather than Opinion

When the NAOMS development process began, researchers found that surveys are viewed with suspicion by many elements of the aviation community. Indeed, surveys can be used to advance political and social agendas. They can be structured in ways that predispose the responses sought by survey operators. Opinion-oriented surveys are notoriously volatile and can shift rapidly in response to current events.

This is why NAOMS emphasizes the collection of data about recalled personal *experiences* rather than personal *opinion*. Most of NAOMS's questions asked respondents whether or not they have personally experienced or observed particular types of events within a specified period of time (typically, the preceding 60 days). NAOMS's emphasis on recalled experience reduces the subjectivity and volatility of the data obtained from survey responses.

While NAOMS surveys did not generally address matters of opinion, exceptions to this policy were made only when specifically requested by stakeholders who were interested in pilot views (i.e., opinions) about a variety of operational and training practices. In addition, NAOMS recognized that human recall is not perfect, and respondents might be reluctant to reveal some unwanted events that they experienced. This introduces some subjectivity and uncertainty into survey data collected by NAOMS.

NAOMS employed well-trained, professional interviewers to conduct its surveys. The NAOMS interviews were performed by the Centers for Public Health

Research and Evaluation (CPHRE), a division of Battelle that is highly experienced in performing surveys involving sensitive information. The rapport developed between NAOMS interviewers and their subjects, enhanced by the promise of confidentiality, encouraged candor.

3.4. Voluntary, Confidential, and Anonymous

Participation in the NAOMS program was completely voluntary. The names of potential respondents were drawn from the Airmen Certification Database as published on the Internet. NAOMS sent a letter to potential respondents requesting participation but making it clear that recipients of the letter were under no obligation to do so. NAOMS's high voluntary response rate was a result of respondents' genuine concern about aviation safety and their trust in the confidentiality guarantees extended by NASA.

All data provided by NAOMS respondents are held in confidence. NAOMS maintains records of who has participated in a survey to avoid unnecessary follow-on mailings,[1] but there is no linkage in NAOMS's data repositories between the names of past respondents and the data they provided. The responses are functionally anonymous.

3.5. Methodological Success Measures

At the onset of the NAOMS program, three key measures of methodological success were identified and are described in the following subsections.

3.5.1. Response Rate

Survey response rate is a key measure of any survey system's success. High response rates increase confidence that the responses obtained from survey respondents are minimally influenced by self-selection bias and can be generalized to the larger population.

3.5.2. Data Quality

The quality of the data collected by a survey effort such as NAOMS can be gauged by the following three indicators:

Outlier Frequency. Properly obtained and recorded high-quality data contain relatively few extreme outliers resulting from misunderstood questions, intentionally misleading responses, or data collection errors. NAOMS's data display relatively few extreme outliers; the ones that are observed are scrubbed to avoid skewing survey results.

[1] NAOMS also used these data during the sampling process to prevent any individual from being asked to participate in a NAOMS survey more than once per year.

Survey Completeness. Survey completeness indicates quality and occurs when respondents answer all, or most, of the questions presented to them. Fewer than 2 percent of NAOMS's respondents broke off their interviews before completion.

Respondent Assessment of Survey Quality. NAOMS asked respondents directly about the quality of the survey process, including the relevance and understandability of questions, and respondents' ability to meaningfully reply to those questions. These responses, presented later, speak very favorably of NAOMS.

4. Development Roadmap

Figure 4-1 shows the sequence of project development steps from project commencement in 1998 through December 2004 when NAOMS data collection ended. During the two subsequent years, NAOMS developed a streamlined version of its data collection system and gave it to the Air Line Pilots Association for continued use on behalf of the aviation community.

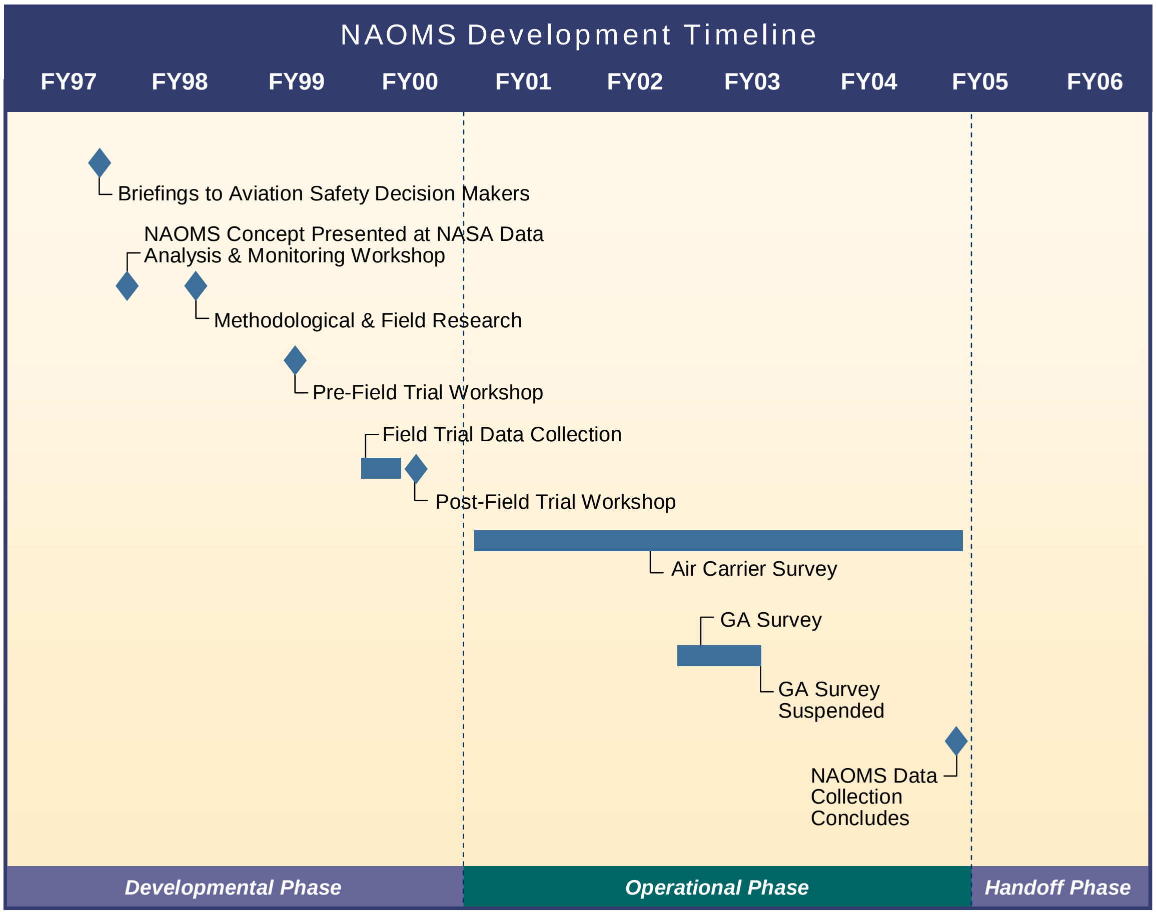


Figure 4-1. NAOMS Development Timeline

4.1. Methods Development Phase

The contractor research team described in Appendix 1 performed the project work under NASA management and leadership. During the early years of the NAOMS program, the team was preoccupied with methodological concerns and the engagement of the aviation community in the NAOMS development process. Key activities included:

- ***Respondent Demographics.*** Data were developed on the size and composition of potential NAOMS respondent populations, such as air carrier pilots, general aviation pilots, and air traffic controllers (see Appendix 2).
- ***Literature Review.*** The NAOMS project team examined published studies to develop a deeper understanding of previous survey research efforts involving aviation personnel, including pilots. The team found that very few aviation-specific studies had been published. Some information was gleaned from analogous work performed in other professional operating domains, such as medicine (see Appendices 3, 4 and 5).
- ***Memory Experiments.*** NAOMS ran a series of small-scale methodological experiments related to pilot memory. These experiments were designed to find out how pilots organized safety events in their memories, and to estimate the time period over which pilots could accurately recall safety events.
- ***Focus Groups.*** Focus groups, and related methods, were used to identify the aviation safety topics of greatest interest to line pilots. With input from focus groups, the team developed a first draft survey instrument, a "strawman" for what eventually became the NAOMS operational air carrier pilot survey. The structural features of the air carrier survey, and many of its survey topics, were carried over to the GA survey (see Appendices 6 and 7).
- ***Field Trial.*** After the research and methodological experiments had been completed, the team developed a sampling plan, using a pure random approach, and conducted small-scale field trial data collection from November 1999 to February 2000. The field trial had several objectives. NAOMS sought additional feedback on the survey instrument, obtained its first measure of probable response rates, further explored pilot recall capabilities, and, importantly, obtained coarse preliminary approximations of the safety event frequencies that respondents would be reporting once NAOMS became fully operational (see Appendix 9).
- ***Workshops.*** NAOMS held two workshops during its development phase. The first of these preceded the Field Trial, and the second followed it. The first workshop, held in May 1999, provided an opportunity for industry participants to review and critique the draft Field Trial questionnaire. The draft questionnaire was revised in response to input from workshop participants. During the second workshop, held in March 2000, attendees were briefed on field trial tests of the NAOMS questionnaire and interview process (see Appendices 8 and 10).

In addition to the two workshops described above, from 1998 through 2005, NAOMS conducted a dozen briefings to external stakeholder organizations about the program's status, and reported preliminary findings to other federal agencies. These briefings are listed in Table 4-1.

Table 4.1. NAOMS Briefings

Date	Audience	Subject
1998-11-13	NASA ASRS Advisory Subcommittee	Development Approach
2000-01-26	Aviation Specialty Corporation (AvSPEC)	Program Overview; Partial Field Trial Results
2002-12-05	NASA Langley AvSP Leadership	Program Overview; Preliminary Results
2003-04-09	FAA	Program View; Results to Date
2003-05-07	National Research Council (NRC) Review Committee	NAOMS Program Review
2003-08-05	FAA and CAST JIMDAT Committee	NAOMS Overview and Status
2003-12-18	NAOMS Working Group	Meeting 1, NAOMS Status and Results Review
2004-05-05	NAOMS Working Group	Meeting 2, NAOMS Status and Results Review
2004-06-16	CAST JIMDAT Committee	Construction of JIMDAT Section C
2004-09-01	FAA	Program Overview, Section C ICAC Results
2005-01-26	CAST JIMDAT Committee	JIMDAT Section C Results
2005-01-28	CAST	JIMDAT Section C Results

4.2. Operational Phase

Through the preceding efforts, NAOMS built a solid scientific foundation for the survey. NAOMS sought approval for the operational survey effort from the Office of Management and Budget (OMB) in 2000, and after receiving OMB approval, went operational in 2001. Data collection continued though 2004. The survey was initially given only to air carrier pilots. General aviation pilots were included later in the survey effort.

- ***Air Carrier Survey Implementation.*** NAOMS started to survey air carrier pilots in March 2001 and continued interviewing until December 2004. More than 25,000 surveys were performed over the 45-month air carrier survey period. (The NAOMS air carrier questionnaire can be found in Appendix 11.)

- *GA Survey Implementation.* In August 2002, NAOMS implemented a second survey focused on general aviation pilots – a diverse group that includes pilots engaged in pleasure flying, on-demand air taxi flights, sightseeing flights, corporate and business flying, and many other aviation activities. General aviation data were collected for nine months. During this period, we conducted 4,777 GA pilot interviews. Data collection ended in May 2003 because of resource limitations. This is a smaller percentage than the air carrier pilots but still an impressively large number.

Table 4.2. NAOMS Response Rates and Surveys Conducted

Item	Quantity
Air Carrier Pilots	
Response Rate*	83%
Surveys Completed	25,105
General Aviation Pilots	
Response Rate*	77%
Surveys Completed	4,777

* Calculated as: completed surveys divided by the potential respondents who were located and determined to be eligible.

Data collection activities ended in mid-December 2004. NAOMS had met its methodological objectives and collected a substantial amount of aviation safety data, but government priorities had changed.

4.3. Handoff Phase

NASA decided to develop a streamlined, web-based version of the NAOMS system to preserve at least some of the public investment in NAOMS. NASA recognized that a web-based survey system might not achieve the same response rates and level of quality achieved by the CATI survey, but NAOMS could continue serving the aviation industry and the traveling public although in a reduced form.

The NAOMS web-based data collection system was developed in 2005, tested in 2006, and conveyed to the Air Line Pilots Association in early 2007 for continuing operation on behalf of the aviation industry.

5. NAOMS Methodology

Professional caliber surveys have not been widely used in aviation safety settings, even though the use of surveys to collect information is a well-established process in other domains. Consequently, numerous methodological questions needed to be explored and answered before NAOMS could become operational.

This portion of our report describes those methodological issues and how they were resolved. We begin by providing an overview of NAOMS's relevant issues. Some of these are obvious to a lay reader. Others are more esoteric but are central to conducting a professional caliber survey and need to be discussed. After this brief overview, we describe NAOMS's approach to resolving each of these issues and summarize the methods NAOMS ultimately selected for the operational survey system. This section closes with a discussion of the methods employed by NAOMS to ensure respondent anonymity.

5.1. Overview of Methodological Issues

At the beginning of the development effort, the NAOMS project team, consisting of NASA, Battelle, and Battelle subcontractors, were uncertain about:

- The appropriate content of NAOMS questionnaires
- How the questionnaires should be structured
- How far back in time respondents could accurately recall safety events
- The best survey collection mode to use
- The source of the respondent names (population pool) that would be sampled and the sample size needed to achieved desired levels of accuracy
- Whether a purely random or a panel sampling design would work best.

NAOMS also needed to find an effective means of locating respondents and engaging their participation in the survey.

5.1.1. Questionnaire Content

To accomplish its research objectives, NAOMS needed to collect four types of information:

(1) Measures of respondent risk exposure, such as the numbers of flight hours and legs flown, which act as the denominator of rate estimates

(2) Estimates of the number of safety incidents and related unwanted events that respondents experienced during the recall period, which act as the numerator of rate estimates

(3) Answer to questions on special focus topics requested by stakeholders

(4) Feedback on the quality of the questions asked and of the overall survey process.

NAOMS developed four-part questionnaires for air carrier and general aviation pilots that addressed each of these needs. Section 5.2.2 describes NAOMS's approach to developing the questionnaires, with particular emphasis on how NAOMS identified the longitudinal safety topics responsive to requirement (2) above.

5.1.2. Questionnaire Structure

The high-level organizational structure of the NAOMS questionnaires was driven by the four content requirements described above. Other structural matters – how the sections were sequenced, how questions were grouped and ordered within each survey section – were influenced by NAOMS's desire to minimize respondent burden and maximize respondents' ability to recall the information sought by NAOMS.

One way to improve memory recall is to take advantage of the ways that people naturally organize memories. The general literature on survey methods covers this general topic in great detail but has very little information on the specific topic of pilot memory organization. Such information, if available, could have been used to optimize the survey question sequence to align with pilot memory patterns. Because this information was not available, NAOMS developed it through the small-scale cognitive experiments described in Section 5.2.2.

5.1.3. Recall Period

NAOMS needed survey respondents to accurately recall safety events and the time frames in which they occurred. NAOMS did not know how far back in time pilots could reliably recall safety events. Knowing this was crucial because more safety events could be "captured" by the survey if respondents were asked to recall events from a lengthy time period, but it was necessary for the timing of events to be recalled accurately. NAOMS ultimately chose to use a 60-day recall period as described in Section 5.2.1.

5.1.4. Survey Mode

Questionnaires can be applied using various techniques or "modes." For example, mailed questionnaires are used to obtain self-administered survey responses. Other survey methods rely on the assistance of trained interviewers. Whether self-administered or assisted, each survey mode has advantages and disadvantages when considering issues such as cost, data quality, and response rate. NAOMS needed to determine the best survey mode for its data collection system. As Section 5.2.4 indicates, NAOMS ultimately decided to use a Computer-Aided Telephone-Interview (CATI) approach.

Web-based Data Collection. At the time NAOMS development began, there were few, if any, well-crafted and methodologically robust web-based surveys. The literature on this topic was minimal. Therefore, NAOMS concluded that this data collection mode was not a viable option during the initial years of NAOMS's operation. During later years of the project, when cost reduction became a preeminent consideration, NAOMS did develop a web-based version of its survey process. The web-based version of NAOMS is described in Section 5.2.4.

5.1.5. Sample Source and Size

The NAOMS team of designers had a rough understanding of the number of air carrier pilots operating in the United States (many tens of thousands), but it needed a more precise number to develop its sampling approach. Once the team had this number, it needed a way to obtain the names and addresses of potential respondents in order to construct a "sample pool." One approach considered was to use the FAA-maintained Airmen Certification Database (releaseable version) to estimate air population size and to obtain contact information. Another was to partner with industry trade groups and/or organized labor to obtain pilot names and addresses for the sample pool. NAOMS ultimately chose to use the Airmen database to obtain the names of potential respondents as described in Section 5.2.5.

5.1.6. Random versus Panel Sampling Approaches

Surveys often are conducted by randomly selecting a participant from the sample pool and conducting the interview. Once the interview is completed, the individual usually is removed from the sample pool to avoid double counting one person's experiences. This is referred to as a "pure random" design without replacement. A variant to this design is to permit, in random fashion, participants to be included in the survey in multiple years, but never in the same year.

Another approach is to randomly select a participant from the sample pool, and ask him or her to periodically complete the survey over an extended time period. This is called a "panel" design. Panel design can allow researchers to measure the experiences of that individual over time. The "Nielsen" survey used to monitor television viewing habits is a panel survey design with which most people are familiar.

Both the random and panel sampling approaches have advantages and disadvantages. NAOMS ultimately decided to use the pure random approach. Section 5.2.6 describes the basis for this decision.

5.1.7. Maximizing Response Rate

Survey systems, such as NAOMS, strive to obtain high response rates. Section 5.2.7 explains how NAOMS achieved its exceptional response rate.

5.2. Resolution of Methodological Issues

The following pages of our report provide a more detailed understanding of how NAOMS developed its survey methodology.

5.2.1. Establishing Questionnaire Content

Each NAOMS questionnaire is comprised of four sections:

- Section A: Respondent Flight Activity Levels (risk exposure)
- Section B: Longitudinal Safety Event Questions
- Section C: Special Focus Topics
- Section D: Feedback on the Quality of the Survey Experience.

While we discuss all four sections of the NAOMS questionnaire in this section, our main focus is on the safety event questions in NAOMS Section B because these questions are longitudinal in nature. They were intended to be asked repeatedly over an extended period of survey operation and could not be changed without introducing discontinuities into the data collection process.

5.2.1.1 Section A: Flight Activity Levels

The data in Section A measure respondent flight activity during the recall period and over his or her career. The former data are crucial to developing safety rate estimates from NAOMS data. Section A data provide the denominators in rate calculations. (Section B and C data provide the numerators.) Section A data can also function as explanatory variables when Section B or C responses are statistically modeled.

In the aviation domain, there are two primary flight activity measures: flight hours and flight legs. Flight hours measure the time spent maneuvering aircraft in the air and, depending on the specific measure used, taxiing on the ground. A flight leg is a segment of flight from takeoff to landing. Flight hours and legs are measures of flight activity, and by extension, these activity data also measure flight crew risk exposure (i.e., the number of opportunities they have to experience a severe incident or accident). This is why these numbers are the key variables used to estimate aviation safety event rates.

Because NAOMS simultaneously collects data on risk exposure (in Section A) and safety events (in Sections B and C), it knows that these two data items will match up properly (i.e., relate to the same operational period and scope of flight activity). This gives NAOMS a major advantage over rate estimation approaches that separately acquire risk exposure and event data.

The level of risk posed by a flight hour or leg can vary depending on:

- Makes and models of aircraft flown
- Flight mission (passenger, cargo, business, utility, recreational, etc.)
- Portion of flying done internationally.

NAOMS acquired data on each of these items through Section A questions. If the respondent flew on multi-crew aircraft, they were also asked to indicate the flight positions they held (Captain, First Officer, Relief Pilot, other). If they flew for an air carrier, they were asked to report the order-of-magnitude size of the carrier for which they flew. In the general aviation survey, respondents were asked about the Federal Aviation Regulation (FAR) Parts under which they flew.

The preceding activity measures are particular to pilots. If NAOMS was extended to other stakeholder groups, such as air traffic controllers or mechanics, a different set of activity/risk exposure measures would be needed.

5.2.1.2 Section B: Longitudinal Safety Event Questions

Section B questions were intended to be collected routinely over a long period (i.e., longitudinally). These data can be used to compute safety event rates and event rate trends. The aviation system is concerned with a great many safety challenges relating to aircraft, airports, procedures, policies, training, air carrier organizational factors, and other aspects of flight operations. NAOMS Section B questions had the potential to address a great many of these topics, but not all at once. A further consideration was that of redundancy. In general, NAOMS did not want to collect the same types of safety data being reliably collected by other means.[1]

Topic Identification

Therefore, NAOMS needed an approach for selecting the highest priority topics and developing questions that would yield valuable insights on them. This work was accomplished in two main steps. First, NAOMS consulted existing aviation safety data repositories maintained by NASA, the FAA, and the NTSB to identify known safety issues. Second, it sought input from aviation domain

[1] A small amount of overlap with other highly reliable data sets was desirable because it would provide a potential means of validating the NAOMS results.

subject matter experts (SMEs) who were asked about the safety issues important to them based on first-hand operating experience.

The NASA ASRS program collects and maintains a very large repository of aviation safety reports. NAOMS consulted with ASRS analysts to identify the recurring and emerging safety issues the analysts saw in ASRS reports. NAOMS also conducted air carrier pilot focus group sessions to identify and prioritize aviation safety issues. Additional ideas were generated during the two workshops hosted by NAOMS.

Focus Groups. The focus groups were held in the Washington, D.C., area in August and September 1998. The pilot participants included 37 active air carrier pilots flying both domestic and international routes. Between 2 and 15 pilots participated in each session. Each session lasted 90 minutes and was led by a professional facilitator. In guiding each session, the facilitator encouraged pilots to mention as many different types of safety-related events as possible. This included anything that should not occur during normal air operations.

All focus group sessions were tape recorded. Later, the recordings were transcribed to paper (after de-identifying the pilot participants). The questions posed to the focus groups are listed in Appendix 6.

One-on-One Interviews. One-on-one interviews were conducted to identify additional events that did not surface in the focus groups. The one-on-one format allows for more intensive discussion between the interviewer and a single pilot than is possible in a group setting. Also, any apprehension that a pilot might feel about mentioning some types of events in front of other pilots is reduced or eliminated during the one-on-one interviews. Nine interviews were conducted in the Washington, D.C., area and in Columbus, Ohio, during September 1998. Each interview lasted up to 90 minutes. These pilot participants included active air carrier pilots flying both domestic and international routes. These sessions also were tape recorded and transcribed, and the identity of the participant removed.

Consolidated Topic List. The list of aviation safety topics generated by the focus group and one-on-one interview exercises is presented in Appendix 7. Decisions about which events to include in the list were driven by a desire to select events serious enough to be good indicators of the safety performance of the aviation system, yet not so serious that they would occur too rarely to be captured in the survey. A few serious rare events were included in Section B. This was done in recognition of strong industry interest in those topics.

To complete the construction of NAOMS Section B, safety topics needed to be grouped and ordered, and then translated into one or more carefully crafted questions. The NAOMS approach to grouping and ordering Section B questions grew out of its research on pilot memory organization, which is addressed in Section 5.2.3. NAOMS depended on the advice of accomplished survey methodologists, and aviation subject matter experts, to craft questions responsive to each survey topic.

5.2.1.3 Section C: Focus Questions

The third section of the NAOMS questionnaire is set aside for special focus topics. Whereas Section B questions were expected to persist over a period of many years to provide a basis for long-term aviation safety rate measures, Section C topics were expected to arise and be the subject of data collection for a few months or years, after which they would be replaced with new topics.

Three Section C question sets were developed over the NAOMS test and operational period. The first of these dealt with minimum equipment lists (MELs). The second dealt with “in-close” changes to approach and landing clearances (ICACs). The third and final Section C question set involved the development of baseline aviation system performance measures requested by a government-industry group known as (CAST-JIMDAT)[2]. The questions developed for each of the Section C implementations can be found in Appendix 11.

Weaknesses Uncovered by the Field Trial. Approximately 9 percent of the pilots interviewed during the field trial indicated that they found one or more of the questions confusing or poorly worded. When a pilot provided this response, they were asked for additional information about the question(s) that caused problems. Most of the difficulties were related to Section C questions. In particular, respondents indicated that the minimum equipment list (MEL) section caused some confusion. The primary concern seemed to be that the questions were ambiguous. There were far fewer negative comments concerning the in-close approach clearances (ICAC) Section C.

The confusion with the MEL section suggests that line pilots are not as familiar with the details of MEL as one might assume, but it might also be that the questions were worded poorly and resulted in confusion for the respondent. NAOMS elected to use the ICAC Section C when the air carrier survey became fully operational in 2001 because respondent views of this question set were generally positive.

[2] Commercial Aviation Safety Team (CAST) Joint Implementation Measurement Data Analysis Team (JIMDAT).

5.2.1.4 Section D: Respondent Feedback Questions

Section D of the survey requested feedback on the interview process and the questionnaire. For example, it asked respondents whether the survey questions asked were safety-relevant, and it asked if they were confident the data provided were recalled accurately. Overall, respondent feedback was very positive and served to increase the NAOMS team's confidence in its methodological approach.

In Section D, NAOMS also asked respondents to identify additional useful safety topics the survey might address in the future. Numerous additional topics were suggested by respondents. These are potential subjects of future surveys.

5.2.2. Determining Questionnaire Organization

As described in Section 5.1.1, the top-level, four-part structure of NAOMS questionnaires was determined by content requirements. Other aspects of the questionnaire's organization were shaped by NAOMS's desire to minimize respondent burden while maximizing respondent recall of safety data.

Research on human cognitive and memory organization demonstrates that memories of similar events are typically stored together in clusters in a person's memory. Therefore, once a respondent begins retrieving memories from a particular cluster, it is easiest and most efficient to recall all other memories in that cluster, rather than jumping to another cluster. The team determined the NAOMS questionnaire would be easiest for pilots to complete if questions asking about events stored near to each other in pilots' memories were grouped together. Such grouping likely leads to improved recall accuracy.

The *a priori* expectations of the research team about possible widely used organizational schemes were derived partly from the organizational scheme used by the NASA Aviation Safety Reporting System (ASRS). These expectations also were derived from discussions with pilots and from reading aviation literature. Using these sources, it was reasoned that pilots might organize safety-related events in terms of their causes (e.g., equipment failures, flight crew mistakes, weather, etc.), the phase of flight in which they occur (e.g., take-off, ascent to cruise altitude, etc.), or their seriousness (e.g., minimal, moderate, or severe). These expectations contributed to the design and analysis of studies designed to determine the optimal question order.

NAOMS used four data collection methods to explore pilots' organization of safety-related events:

(1) **Autobiographies:** The first method involved the least structuring by researcher expectations. Pilots were asked to recall all of the aircraft safety

problems they had witnessed in their careers. This study was conducted to gain initial insight into how pilots thought about safety-related events.

(2) **Sorting:** NAOMS constructed a list of 96 hypothetical safety-related events. Pilots sorted the 96 events into groups, indicating which events seemed most similar or related to one another. NAOMS used this activity to measure pilots' perceptions of linkages among the events, on the presumption that events clustered together in memory are seen as especially similar or related to one another. The groups identified in this experiment became the main categories of NAOMS's Section B questions described in Table 4-2.

(3) **Recall:** Pilots performing the recall activity read the 96 events and later recalled as many of the events as they could. This activity also was used to infer the organization of safety-related events in memory, because the order in which the events were recalled indicates how those events were stored in memory.

(4) **Confirmational Experiment.** Results from the autobiography, sorting, and recall procedures suggested that a hybrid organizational scheme was used most commonly by pilots. To test whether this was, indeed, the predominant organizational scheme, a final set of pilots read the 96 events and later tried to recall them. Each pilot was given one of three sets of cues or no cues at all. Researchers tested whether providing cues based on the hybrid scheme facilitated the most recall.

As a result of these experiments (described further in Appendix 4), NAOMS concluded that pilots use a hybrid structure to organize aviation safety measures, which combines elements of the phase- and cause-based organization schemes that researchers had hypothesized. Table 5-1 describes that scheme. These findings were used in the final design of the NAOMS pilot survey instruments.

Table 5-1. Organization of Safety Events in Pilot Memory

Category	Scope
Aircraft Equipment	Any aircraft equipment-related problem
Turbulence	Turbulence encounters due to wake or weather
Weather	Weather problems other than turbulence
Passengers	Any passenger-related problems
Airborne Conflicts	Any conflicts with other aircraft in the air
Ground Events	Runway and taxiway transgressions, ground conflicts, and all other ground-based events
Flight crew	Flight crew performance issues other than those resulting in airborne conflicts, ground events, or altitude deviations
Altitude Deviations	Any deviation from assigned altitude
ATC Interactions	Events rooted in pilot-ATC interaction difficulties

It is important to note that the studies reported here do not indicate that every pilot organized all of his or her memories according to this hybrid scheme. Across the four studies, clear evidence of differences among pilots appeared. Some of this heterogeneity could be attributed to imprecise measurement, but it is likely that many of these differences are real. NAOMS concluded only that the hybrid scheme it chose to follow is the best known model of pilot memory structures and that using a survey question order that mirrors that structure could best facilitate recall.

Question Ordering within Section B Topic Areas

Once the main Section B survey topics had been resolved, NAOMS addressed the issue of how to sequence subtopics/questions within each topic area. One possibility was to present the questions in a random order within each question group (i.e., topic area). However, more complete and accurate recollection occurs when topic order is driven by methodological considerations.

Research in cognitive psychology has demonstrated that recalling strong memories (i.e., those that are vivid and easy to recall) makes it more difficult then to recall weaker related memories (i.e., more common, everyday occurrences; McGeoch, 1942; Mensink & Raaijmakers, 1988; Slamecka, 1968). This suggested that it would be a mistake for NAOMS to order questions in a topic group starting with the most severe event type and progressing toward less severe, which might interfere with a pilot's ability to recall less familiar and/or powerful events listed later in the topic group. NAOMS followed this guidance as it finalized Section B of the air carrier questionnaire. This same structure (with limited modifications) also was carried over to the GA pilot questionnaire.

5.2.3. Pilot Recall Period

Respondents' ability to accurately recall operational and safety events had implications for Sections A, B, and C of the NAOMS questionnaire. All of these survey sections ask respondents to report on some set of experiences that occurred within a specified recall period.

From the vantage point of survey efficiency, longer recall periods are desirable. They enable more safety events to be "captured" per interview allowing higher levels of statistical accuracy to be attained for the chosen sample size. However, the accuracy of memory fades with time, causing data quality to decline as the recall period increases. NAOMS's goal was to find the longest recall period that practically could be used without compromising survey quality.

It is not clear that workable recall periods should be the same for all aviation respondent groups. For example, pilots and controllers work in very different environments with different task loadings, opportunities for memory interference, etc. Since NAOMS's initial concern was air carrier pilots' recall ability, it first focused on this group knowing it might be necessary to perform additional studies to gauge the recall capabilities of controllers and other types of aviation operating personnel if the NAOMS data collection effort widened to include them.

Literature. Based on the cognitive psychology literature on memory and the experience of survey researchers, three types of misremembering might impact the accuracy of survey responses. First, respondents might forget events that occurred. Second, they might remember real events but misremember the dates on which they occurred; events could be remembered as being further back in time or closer in time (a phenomenon known as "telescoping"). Third, respondents might imagine events that never occurred (perhaps derived from a general sense that certain kinds of events typically happen "roughly once every 'X' weeks"). The NAOMS survey instrument needed to employ a recall period that kept these potential errors at acceptable levels.

Experiments. A small-scale pretest study was conducted to help identify the most appropriate recall period for air carrier pilots. In this study, pilots were asked to perform a relatively simple memory task: remembering the number of landings they had performed recently. NAOMS compared the data provided by pilots to their flight logs. This research indicated pilots could recall these routines events with very high accuracy for one week after their occurrence; thereafter, accuracy declined.

The question remained whether pilots could accurately recall more unusual occurrences, such as safety events, for a longer period of time. NAOMS postponed the resolution of this issue believing that the upcoming field trial provided the best opportunity for exploring it more carefully.

Field Trial. During the field trial, researchers randomly assigned respondents to one of six recall periods: one week (seven days), two weeks (14 days), four weeks (30 days), two months (60 days), four months (120 days), and six months (180 days). The NAOMS team anticipated that shorter recall periods would minimize recall error, based on cognitive psychology literature on memory.

Researchers compared the number of safety events remembered for the various recall periods used during the field trial. As expected, the absolute number of events remembered increased as the recall period increased. However, the reported number of events per flight leg (the event rate) declined as the recall period increased. It appeared that even if pilot respondents had "telescoped" some more distal events closer in time, this was more than offset by the number of events they had collectively forgotten.

Another way to address the effect of recall period on data quality was to ask respondents how confident they were in their answers. The results are summarized in Figure 5-1, which demonstrates that confidence levels dropped as recall periods grew longer. However, at 60 days, 85 percent of respondents still indicated that they were either "extremely" or "very" confident in their event reporting.

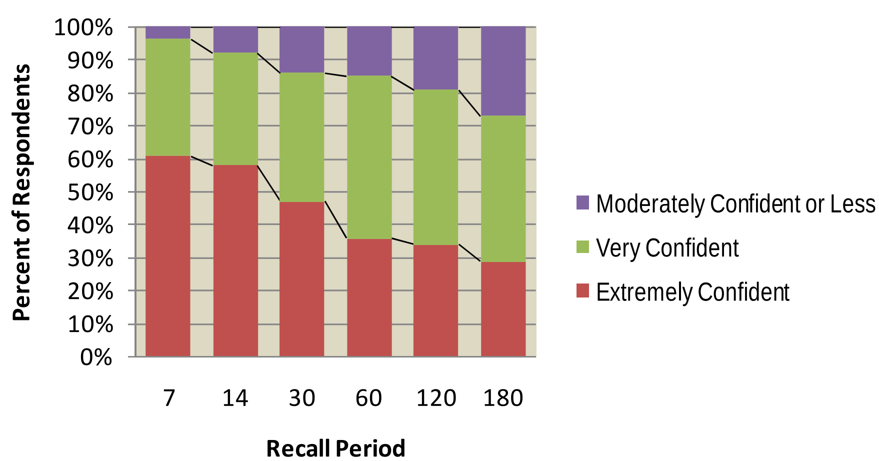
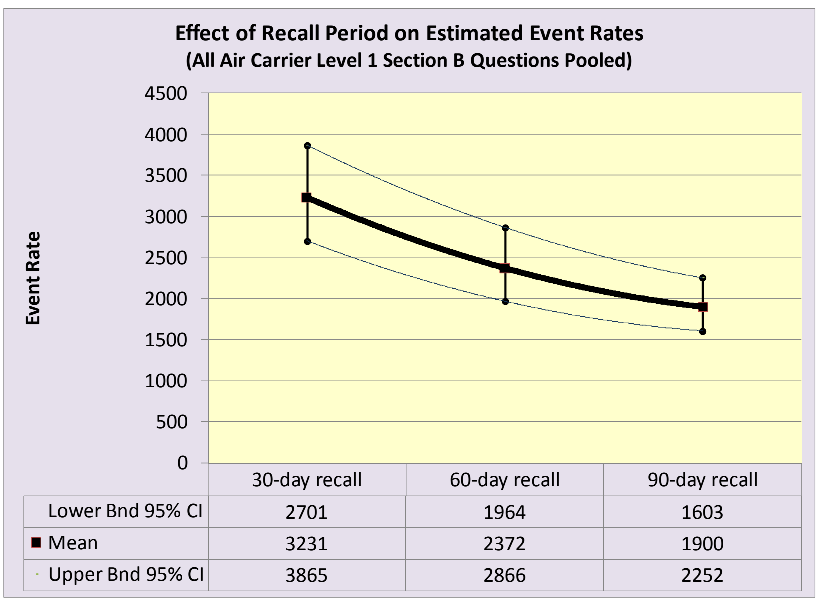


Figure 5-1. Confidence in Responses Declines as Recall Period (in days) Increases

Data quality was just one of two competing considerations for choosing a recall period. Cost was the other consideration, and it favored longer recall periods because target confidence intervals for event rate estimates can be achieved with fewer interviews as the recall period increases. It was clear that any recall period in excess of 90 days was unlikely to produce an acceptable level of data quality (i.e., recollection accuracy.) However, the quantity of data collected during the field trial was not sufficient to entirely settle this issue. Some members of the team favored a 30-day recall period because the data indicated that relatively few safety events would be forgotten in this short time interval. Others felt that this strategy was too conservative and that a longer recall period should be used for reasons of efficiency even if measured event rates tended to understate true event rates by a small amount. Final resolution of the recall period issue was deferred until the first year of actual NAOMS operation.

First Year of NAOMS Operation. NAOMS used a *two-way* split-design during its first year of operation. Half of the respondents were asked to use a 90-day recall period, and the other half were asked to use a 30-day recall period.

NAOMS then used a *three-way* split design (30-, 60-, and 90-day recall periods) to confirm findings related to the recall period. This second test was run for two months early in 2002. To understand the effect of the recall period during this second test, we pooled the data for all of the questions and then ran an analysis to measure the change in both the mean event rate and the confidence interval about that rate as the recall period increased. The results are shown in Figure 5-2.



	30-day recall	60-day recall	90-day recall
Lower Bnd 95% CI	2701	1964	1603
Mean	3231	2372	1900
Upper Bnd 95% CI	3865	2866	2252

Figure 5-2. Effect of Recall Period on Estimated Event Rates

The results were consistent with the data collected during the earlier 30-day versus 90-day recall period comparison. The total number of events recalled per flight leg did decline for each month added to the recall period. By this measure, respondents using a 60-day recall period remembered, on average, 27 percent fewer events per flight leg than those using a 30-day recall period; those using a 90-day recall period remembered roughly 41 percent fewer events per flight leg than those using a 30-day recall period. However, the confidence intervals also tightened as the recall period increased.

NAOMS subsequently made the decision to use a 60-day recall period because it provided a reasonable balance between the need to recall as many safety events as practical while avoiding inordinate memory-related errors. It should be noted that the use of either the 30-, 60-, or 90-day recall period does, on average, create a downward bias in event rate estimates compared to a more "instantaneous" recall period such as seven days.[3] (i.e., the rate estimates are conservative).

5.2.4. Survey Mode

Surveys can be conducted in a variety of modes. NAOMS evaluated the three most common survey data collection modes: (1) self-administered questionnaires (SAQ); (2) computer-assisted telephone interviews (CATI); and (3) in-person interviews. When choosing a survey administration mode, a number of considerations are relevant. The four criteria influencing this choice are: (1) collection cost; (2) respondent satisfaction; (3) response rate; and (4) data quality. (For a thorough discussion of the first three of these criteria, see Weisberg, Krosnick, & Bowen, 1996, pp. 121-127.)

Literature. There is a substantial body of literature on survey modes and their relative strengths and weaknesses. NAOMS's review of the pertinent literature reviewed the following:

- *Mode Literature on Cost.* The literature indicates that on a per-interview basis, in-person interviews typically are the most expensive; telephone interviews often are significantly less expensive; and SAQs generally are the least expensive. However, if efforts are made to achieve the highest response rates possible with SAQs, then the cost of that mode is close to the cost of applying the same questionnaire via the telephone.
- *Mode Literature on Respondent Satisfaction.* Respondent satisfaction metrics favor in-person interviewing. In a study comparing respondents interviewed in-person and by telephone, Groves (1979) found that 78 percent of the in-person respondents were satisfied with the experience, whereas only 38 percent of the telephone respondents said they were satisfied.
- *Mode Literature on Response Rate.* When comparing for response rate, in-person interviewing again proves superior to other modes. It is widely

[3] Because the fall off in respondent recall with increasing recall periods appears to be nonlinear, the event rate estimates associated with the 60-day recall period do not fall exactly midway between those associated with the 30- and 90-day estimates. However, they are close enough to the midpoint that it is reasonable to combine them with the 30- and 90-day data collected during Year 1 when event rates are estimated.

accepted that in-person surveys can achieve 70 percent or greater response rates, telephone surveys can achieve a 60 percent response, and mail surveys generally achieve 10 to 20 percent response rates unless heroic efforts are implemented (Dillman, 1978).

- *Mode Literature on Data Quality.* Two other important considerations for NAOMS were not widely recognized in the literature on modes: satisficing and social desirability bias. In general, modes that encourage these phenomena also compromise data quality.
  - **Satisficing.** Surveys can require respondents to do a great deal of cognitive work for little or no real reward (Krosnick, 1991). This can lead to *satisficing* behavior. When this happens, respondents exert the minimal effort needed to *satisfy* survey requirements. Responses are not always well thought through and are more likely to contain bad data. From the satisficing perspective, the literature indicates that telephone interviews are least desirable, and self-administered questionnaires work as well or better than in-person interviewing.
  - **Social Desirability Bias.** Social desirability bias describes the tendency of respondents to answers questions in a way that present them to interviewers in a respectable light – even if it requires the truth to be "bent" or ignored. The literature suggests that SAQs appear to minimize social desirability bias, while telephone interviews maximized this bias.

  The results of this review are described in more detail in Appendix 5.

- *Summary of Data Collection Mode Literature.* SAQs are often less expensive to run and they scored high marks for delivering quality data. However, they also have disadvantages. They usually have significantly lower response rates than other survey modes, and it is difficult to implement complex skip patterns in paper-based SAQs.

When considering respondent satisfaction and response rate, the literature review favored in-person interviews, but it is a very expensive survey approach.

With no clear winner, the NAOMS project team determined additional research was needed to select the most appropriate interview mode for the initial population of air carrier pilots. It was determined that the most efficient method to conduct this additional evaluation would be to test the different survey application methods during the field trial. In this way, response rate, data quality, cost, and other key indicators could be compared.

Field Trial. During the field trial, surveys were performed using three alternative data collection modes: (1) SAQ; (2) CATI; and (3) in-person interviews.

- **Advance Letters.** For all three collection modes, advance letters were mailed to all pilots on NASA letterhead and signed by the NASA project manager. The letter informed pilots of the study's purpose and the selection process. It committed NASA to maintaining the confidentiality of survey responses.
- **Interviewer Training.** Both the CATI and in-person data collection modes required trained interviewers. Interviewers serve as the interface between survey operators and respondents. Well-trained, poised interviewers are essential to the success of a professional survey effort.

Nine lay interviewers were trained for the NAOMS field trial. They trained together for a total of 12 hours, with supplemental one-on-one training thereafter. Interviewers were introduced to the study, its background, and purpose, and they were given an overview of aviation and aircraft terminology. The interviewers were briefed on the different versions of the questionnaire, the advance letters, confidentiality, and various administrative forms and procedures. Group role-playing helped interviewers practice administering the questionnaire and to anticipate responses to potential questions pilots might ask.

Each interviewer's knowledge was validated by conducting test interviews (actual interviews with NAOMS supervisors) where they were challenged with errors, balking, and more. Finally, the interview process, itself, was carefully scripted. Interviewers were very disciplined and did not depart from the script. NAOMS developed standard responses for the interviewers for those few questions where pilots might ask for additional clarification. At no point were interviewers allowed to depart from the script.

While it might be thought that it would be important to have trained aviation personnel conducting NAOMS interviews, in fact, it is far more important to have professional and experienced interviewers conducting interviews. Lack of expert knowledge can be a benefit since the interviewers are only recording what they hear rather than interpreting it through the lens of their own experiences. NAOMS wanted every interview conducted in exactly the same manner to minimize the interviewer's influence on the participant responses. This is standard survey methodological approach and has been verified time and time again as the best approach to collecting quality data.

Self-Administered Questionnaires. SAQs were administered in several stages following the Dillman principles or Dillman design method to maximize response rate and data quality.

The advance mailing received by potential SAQ respondents told them to expect a follow-up mailing that would include the questionnaire. This first mailing was followed a week later by a packet that included a cover letter; the questionnaire; a pre-addressed, postage-paid return postcard; and a pre-addressed, postage-paid return envelope. Respondents were asked to affirm their eligibility and intention to participate on the return postcards. Each postcard contained an identification number that allowed Battelle CPHRE staffers to eliminate pilots from the sample pool who were ineligible or who indicated they did not wish to participate in the survey.

A week after sending the first packet, Battelle CPHRE staffers mailed a postcard to participating pilots. This postcard reminded pilots to return the questionnaire if they had not done so, but to ignore the postcard if this task was completed. One week later, a second packet was mailed. Except for a slightly revised cover letter, this packet was the same as the first packet.

Computer Assisted Telephone Interviews (CATI). After being certified, CATI interviewers began making calls from the telephone center at Battelle using CATI versions of the questionnaire. Interviewers were silently monitored by Battelle CPHRE validation staff. The introductory telephone script notified pilots that supervisors could monitor calls for quality assurance purposes.

In-Person Interviews. Certified Battelle CPHRE field interviewers called pilots and scheduled appointments for in-person interviews. Pilots were allowed to choose an interview location, including a home or domicile airport. Interviewers conducting in-person interviews were required to wear photo-ID badges identifying them as members of the study workforce. Interviewers also carried a letter, signed by the NASA project manager, identifying them as legitimate interviewers for the study.

Interviewees were asked to provide mailed feedback on the quality of the interview experience using a form supplied by Battelle CPHRE.

Field Trial Findings

The NAOMS project team began the field trial with the understanding that there were positive and negative aspects for each of the three collection modes – SAQ, CATI, and in-person interviewing. Although in-person interviewing proved effective, this mode was terminated early in the field trial due to the excessive time and cost of implementation. As a result, findings are presented for only CATI and SAQ methods.

Collection Mode Effect on Cost. The NAOMS field trial provided an opportunity to strengthen earlier estimates of the cost of conducting the survey. As noted above, it quickly became apparent during the field trial that the in-person interview mode would be cost-prohibitive because of difficulties arranging the interviews and the time it took to conduct them.

As expected, the least expensive data collection method proved to be the self-administered questionnaire. Based on field trial numbers, the NAOMS project team estimated that data collection costs for a fully operational program would run $85 per CATI interview and $67 per SAQ. This estimate is in 1999 dollars and is based on a survey questionnaire of moderate length.

Collection Mode Effect on Data Quality. Evaluation of the time needed to complete the interview is a relative measure of data quality. The underlying assumption is that the more time a respondent takes to complete a questionnaire, the better the quality of the resulting data.

On average, respondents interviewed by CATI spent 40 percent more time on the survey than those who completed a SAQ during the Field Trial, as shown in Table 5-2. The shorter amount of time needed to complete the SAQ is likely indicative of pilots working through the questionnaire quickly, paying less attention to questions, and spending less time trying to accurately recall events.

Table 5-2. Questionnaire Mean Completion Time

Mode	Minutes
Self-Administered (SAQ)	17
Telephone (CATI)	29

Another way to evaluate data quality is to look at the number of missing responses for the questionnaire. As shown in Table 5-3, there were no missing responses for the telephone mode of interview during the Field Trial. The lack of any missing answers for the telephone mode is due to the fact that each question, when read by the interviewer, requires a response. Since most of the responses to the NAOMS field trial questions appropriately received the response of "0" (denoting safety events that did not occur during the reference period), it is easy to see how respondents would be tempted to skip quickly across questions in the survey instrument. This would also explain why the mail version of the survey instrument took so much less time to complete than the telephone version.

Table 5-3. Respondents Failing to Complete at Least One Question

Mode	Percent
Self-Administered (SAQ)	4.8%
Telephone (CATI)	0.0%

The observed relationship between the reported number of events and the total hours flown in the recall period also provides insight into data quality. If the questionnaire is capturing accurate responses from pilots about the frequency of events they experience, then pilots with more flight time should experience and report a proportionately greater number of events than those pilots who flew fewer hours. Several quantitative analyses were done looking at the association between the number of events reported and the number of hours flown during the recall period. As shown in Table 5-4, associations for both CATIs and SAQs were positive, meaning that the number of safety events increased in conjunction with reported flight activity during the recall period. However, the CATI data showed a greater number of events being reported per hour flown, suggesting a more deliberate approach to completing the survey.

Table 5-4. Relationship between Number of Events Experienced and Hours Flown During Field Trial

Mode	Unstandardized Regression Coefficient	Significance	Number of Respondents
Self-Administered (SAQ)	.086	p<.001	223
Telephone (CATI)	.136	p<.001	220

Collection Mode Effect on Response Rate. Table 5-5 presents the response rates by both CATI and SAQ modes. Both of these response rates are considered excellent. It should be noted that for most respondents, more than one request was required before a successful interview was accomplished, regardless of mode. Follow-on contacts were needed because the pilots did not respond to earlier requests, had scheduling conflicts, lost the original mailing, etc.

Table 5-5. Response Rates by Mode During Field Trial

Mode	Percent
Self-Administered (SAQ)	70%
Telephone (CATI)	81%

5.2.5. Sample Source and Size

NAOMS designers had a rough understanding of the number of air carrier pilots operating in the United States (many tens of thousands) but it needed a more precise number to develop its sampling approach. To obtain this number, it assembled demographic data on U.S. air carriers from a variety of sources (see Appendix 2). These data indicated that there were roughly 130,000 pilots in the United States with air transport pilot ratings at the time NAOMS was being designed. But the data were unclear as to how many of these persons were actively flying for commercial air carriers.

5.2.5.1 Sample Source

NAOMS needed to find a way to obtain the names and addresses of these potential survey respondents to construct a "sample pool." One approach considered was to use the FAA-maintained Airmen Certification Database[4] to estimate air population size and to obtain contact information. Another approach was to partner with industry trade groups and/or organized labor to obtain pilot names and addresses for the sample pool.

NAOMS ultimately chose to use the Airmen database to obtain the names of potential respondents. There were policy and logistical reasons for doing so. From a policy standpoint, engagement with various stakeholder groups might limit NAOMS's independence since these organizations might have preferences regarding which topics NAOMS addressed and how its questions were phrased. Use of the publicly available Airmen database avoided this complication.

It also was clear that it would be logistically simpler to sample names from the single list provided by the Airmen database (which is available to the public) rather than gather names from a variety of stakeholder organizations. Each of these organizations was likely to have a unique address list format as well as internal privacy and policy considerations restricting the sharing of these addresses with an external organization like NAOMS.

To identify air carrier pilots in the Airmen database, NAOMS select pilots who designated themselves as U.S.-based, commercial aviation pilots flying multi-engine planes. NAOMS knew that a portion of the potential respondents identified in this manner might be ineligible because the Airmen database information is not always current.

Use of Telematch

Although many pilots update their information online, most of the Certification database records were two years old. Telephone numbers were not available in the database. In order to identify pilots currently living at the address provided, NAOMS selected only those pilots for whom telephone numbers could be obtained through Telematch, a service that matches names and addresses with telephone numbers. In all interviewing modes, NAOMS sampled only pilots for whom telephone numbers could be obtained.

[4] More precisely, NAOMS obtained pilot names from www.landings.com whose data are derived from the FAA Airmen Certification database.

5.2.5.2 Sample Size

The field trial data suggested that 5,000 to 10,000 surveys would need to be conducted each year to attain solid statistical estimates for a majority of NAOMS air carrier Section B questions. Subsequent simulation studies suggested that as many as 65,000 interviews would need to be conducted each year to achieve rate estimates with tight confidence intervals for every NAOMS air carrier Section B question. The last was far in excess of NAOMS's budget and might impose excess burdens on the respondent community.

A decision was made, driven by both budgetary and statistical considerations, to aim for 8,000 completed air carrier surveys each year, knowing that this would permit NAOMS to achieve event rate estimates with tight confidence intervals for a significant portion of Section B questions and rate estimates with broader confidence intervals for remaining questions. This was the target used for the 3.75 years of the operational survey. In practice, the actual sample attained for air carrier pilots was closer to 7,000 surveys annually, bringing the total sample for the 2001 to 2004 time period to 25,105 interviews completed.

5.2.6. Choosing Between Random versus Panel Sampling Approaches

As noted previously, surveys most often are conducted by randomly selecting a participant from the sample pool and conducting the interview. Once the interview is completed, the individual is usually removed from the sample pool to avoid double counting one person's experiences. This is referred to as a "pure random, without replacement" design. A variant of this decision is where the individual is allowed to contribute to the survey from year-to-year, but not more than once in a given year. This approach will henceforth be referred to as a "random" design.

Another approach is to randomly select a participant from the sample pool, and ask him or her to periodically complete the survey over an extended time period. This is called a "panel" design. Panel design can allow researchers to measure the experiences of that individual over time. The "Nielsen" survey used to monitor television viewing habits is a panel survey design with which most people are familiar.

Both the random and panel sampling approaches have advantages and disadvantages. NAOMS evaluated both approaches but ultimately chose to use a random design.

Field Trial. Due to the brief duration of the field trial, it was not possible to explore the issue of random versus panel designs because the panel approach requires repeated interviews with the same pilot over the course of a year.

Accordingly, an examination of this issue was postponed until the initial operational phase of the program.

Initial Operating Experience. During the first year of operation, NAOMS used a split-design whereby approximately half of the interviews were obtained from respondents chosen on a purely random basis and the other half from respondents who agreed to join a NAOMS panel. NAOMS evaluated data from the two sources at the end of its first year of operation. The responses from the two groups appeared to be roughly the same.

Final Decision. NAOMS then decided to use a random approach during subsequent data collection efforts. Four factors led to this decision. First, the use of the panel approach for NAOMS initially was suggested because it was believed that enlisting respondent cooperation in this manner would produce a higher response rate and higher response quality. Once it became clear that NAOMS would achieve a very high response rate and quality from randomly selected respondents and that virtually all of the randomly selected persons who agreed to participate would complete the survey, this motivation disappeared.

Second, panel designs result in fewer degrees of freedom (independent observations) in a data set because when the same persons are interviewed repeatedly – these repeated observations are not truly independent.

Third, the existence of repeat observations can be statistically useful if these repeated measurements can be analyzed across time. However, NAOMS respondent de-identification policies made this impossible. So the cost measured in lost degrees of freedom would not be offset by any gain in analytic capability.

Finally, panel designs are logistically more complex to administer. With no compelling advantage attributable to the panel approach, there was no reason to incur this added burden.

5.2.7. Maximizing Response Rate

The NAOMS questionnaire and the various mailings preceding survey administration were devised to maximize response rate and quality. In these regards, the team followed the guidance of Dillman (1978), who identified some of the most effective ways of attaining these goals.

Literature. Using psychological research on attention, information processing, and compliance, as well as empirical data from surveys conducted using his recommendations, Dillman (1978) identified several methods to increase respondent attention to, and understanding of, survey questions in both mail and telephone interview formats. For example, to motivate potential respondents to complete the survey and to complete it accurately, Dillman recommends informing respondents of the potential rewards and low cost of participating in the survey (e.g., the respondent would be participating in a survey that would take little time but would be a valuable source of information for aviation decision-makers).

To maintain respondent motivation and ability to answer survey questions accurately, Dillman made recommendations about the format of the questionnaire itself. The order and organization of the questions should be clear and logical to respondents. Each question should be clearly and unambiguously worded. Instructions for skipping items should be clear. It should be obvious how and where on the page the respondent should answer a given question. Answering should be made as easy and as fast as possible.

Adherence to the Dillman survey design method yielded very important benefits to NAOMS in terms of high response rate and data quality.

Form of Mailed Invitation. A small experiment was conducted with the mailed self-administered mode to determine if the mailing method would influence response rate. Other survey results have indicated that increased response rates are associated with packets sent by priority mail. To see if this would occur with NAOMS, half of the first self-administered mailing was sent by U.S. Postal Service (USPS) Priority Mail while the other half was sent by regular USPS First-Class Mail. The response rate was essentially the same for both groups.

5.3 Maintaining Respondent Confidentiality

Because pilots were being asked to report sensitive information, Section B and C questions were carefully phrased to avoid asking pilots directly about their performance. (For example, many questions began with the phrase, "How many times did an aircraft in which you were a crewmember ...")

More importantly, many other confidentiality checks were established to protect the information pilots provided.

- Pilots were assigned identification numbers for administrative purposes, but data were stored with complete anonymity
- The computerized interview form did not contain a pilot-identification number or any other form of identification linking a pilot to a completed interview
- No link was maintained between the interview form and the pilot data file after the survey interview was completed.

These controls produced the desired results. There were no breaches of respondent confidentiality or anonymity guarantees during the NAOMS development or operational periods, or thereafter.

6. Development of a Web-based Version of NAOMS

By 2004, it was clear that NAOMS had met its key technical objectives. Data collection was proceeding smoothly with a very high response rate. Respondent feedback on Section D continued to be positive and the expression of interest in NAOMS outputs by the CAST-JIMDAT group bode well for NAOMS continuing use as a means of monitoring the effectiveness of aviation safety interventions.

Despite all of the preceding good news, NAOMS funding requirements – in the neighborhood of $1M per year for each constituent group surveyed – posed a difficulty. The government concluded that there were higher priority claims on these funds. However, it but did not want to lose the substantial public investment in the development of NAOMS. NASA decided the best path forward was to find a means of greatly reducing NAOMS operating costs – even if some reduction in data quality resulted. The next step would be to find an organization that would assume control of the streamlined NAOMS data collection system. In this way, NAOMS could continue to support aviation industry safety efforts albeit in a more limited way than originally envisioned.

The streamlining approach that was found to be the most cost-effective was web-based data collection. The organization that accepted handoff of the NAOMS data collection system was the Air Line Pilots Association (ALPA) who planned to operate it on behalf of the CAST-JIMDAT.

6.1. Opportunities for Cost Reduction

NAOMS actively explored ways to reduce its costs. It was clear that the single method available to greatly reduce data collection costs was to transition from a CATI to a web-based data collection mode. This would avoid interviewer-related expenses. Additional savings could be achieved by:

(1) Drawing potential respondent names from a pre-vetted lists developed by cooperating aviation stakeholder groups rather than from the Airmen Certification Database; this would eliminate or minimize the cost of locating respondents or querying ineligible respondents.

(2) Soliciting respondent participation by email rather than the U.S. Postal Service (USPS); this would eliminate all of NAOMS' paper- and postage-driven expenses.

Taken together, these actions appeared to have the potential for reducing NAOMS data collection costs by 80 percent or more.

6.2. Web-based Data Collection Quality

The cost advantages of the web-based data collection approach were clear. However, there were important unanswered questions about how these changes might impact survey quality. Web-based data collection is a new variation of the self-administered questionnaire (SAQ) survey mode. The observations made about the quality of data collected via the SAQ mode (data quality is generally weaker than that acquired by CATI) applies to web-based surveys. There are additional considerations related to the electronic versus paper-based nature of the questionnaire.

Positive Effects

Easier Population of Tables. In NAOMS's experience the web-based format seems to be better suited than CATI to collecting Section A flight activity data (flight legs, flight hours, etc.). This is particularly true of the NAOMS general aviation Section A, which is relatively complex.

Time to Think. Under a web-based data collection approach, it is practical for respondents to stop and ponder a response, consult logbooks, or do other types of data lookup that are impractical with a phone-based interview.

Concerns

Interface. A NAOMS web-survey application would need to have a pleasing interface that would present questions to the respondents with the same clarity as phone interviewers. It would need to follow the "skip patterns" (the capacity to skip over irrelevant questions and drill-down into pertinent follow-on questions) built into the CATI system, must be able to satisfy respondent requests for clarifying information, and must be able to validate user responses to close-ended questions as well as the CATI-system does. All of this is possible with existing web-based survey technology. However, as Appendices 11 and 12 demonstrate, NAOMS survey questionnaires are far more complicated, and much lengthier, than typical web-based surveys.

Response Rate. As noted earlier, NAOMS achieved exceptional high response levels seen during the 2001-2004 evaluation period. NAOMS understood that two of the key reasons it achieved its exceptional response rate was because of the prestige that the NASA brought to the data collection effort and because of NAOMS's use of the Dillman design method. These advantages would be lost under a web-based data collection system administered by another organization.

Complete Rate. NAOMS interviewers were very effective at establishing rapport with respondents. The proof of this is that fewer than 2 percent of NAOMS's telephone interviews were prematurely ended by respondents even though they often ran more than one-half hour. In the absence of a human interviewer, it would be relatively easy to disengage from a NAOMS web-based survey session. This concern is supported by the research cited earlier that shows SAQs tend to receive less complete responses than CATI surveys.

Quality of Responses. As noted earlier, it is possible for respondents to be more deliberate while completing a web-based survey than during a CATI phone interview. However, it also is possible to rapidly skim through a web-based survey and respond to questions with minimal thought. It is not possible to do this in a CATI setting because the interviewer paces the survey and presents questions one-by-one.

Potential Data Discontinuity. A major risk of a change from a CATI to a web-based collection mode is that this transition would affect the information provided by respondents and thereby create a discontinuity between the four years of preexisting NAOMS data collected via a CATI mechanism and that which would be collected under a web-based NAOMS. The available research literature strongly suggests that some such discontinuity will occur because of the factors described in preceding paragraphs. Thus, it might be difficult to interpret differences between the data collected by the NAOMS CATI and web-based approaches. Would such changes in the data represent real world changes in aviation safety? Or would they simply be artifacts growing out of the NAOMS data collection mode change?

6.3. Creation of the Web-based Data Collection Application

NAOMS created an initial web-based version of the air carrier survey using a commercial-off-the-shelf (COTS) web survey product. However, it proved difficult to program the complex skip patterns used by NAOMS and the testers founds the one-screen-per-question approach used by this product (and a variety of other off-the-shelf web-based survey products) to be off-putting because NAOMS respondents are asked to answer more than 100 questions in a typical survey session.

A second implementation of the NAOMS air carrier questionnaire proved to be much more effective. NAOMS identified a product with substantially greater programming flexibility than most COTS web-survey applications, ILLUME, which is vended by DatStat, Inc. This new tool overcame the problems observed in the initial test and evoked positive responses about the user interface during a subsequent web-based data collection experiment.

6.4. *Web-based Experiment*

NAOMS conducted a small trial using the web-based application it had developed. One-thousand pilots were invited to participate in the survey. The survey invitations came on NASA letterhead. The invitational mailing method was the same as that employed for the CATI survey, except that follow-on mailings did not occur for the web-survey but had for CATI. This was consistent with the planned operation of the web-survey operation in a reduced cost environment.

The trial ran for two months. Figure 6-1 describes the number of potential respondents who were located and determined to be eligible and who participated in the survey.

Table 6-1. Web-survey Response and Completion Metrics

Metric	Quantity		Comparisons		
	CATI[1]	WEB	Relative Measure	CATI	WEB
#1 Total Sample	52,570	1,000			
#2 Not Located or Ineligible*	21,647	44	#2 ÷ #1	42%	4.4%
#3 Completed	25,105	128	#3 ÷ (#1 - #2)	81%	13.4%
			#3 ÷ #1	48%	12.8%

* These are persons who have been contacted, responded, and declared themselves ineligible.

For those potential participants who responded to NAOMS invitations, the eligibility and participation rates were very similar between the CATI and web NAOMS variants. The big difference was in the way potential survey participants responded to invitations to participate in the survey. The large majority of participants who were located and received a CATI invitation responded to NAOMS, but only a relatively small portion of those whose participation was sought in the web survey responded. Roughly 10 percent of web-based survey respondents broke off before completing the web-based survey. By contrast, only 2 percent of CATI participants broke off before survey completion during the earlier data collection efforts.

These results were disappointing, but not wholly unexpected for the reasons described in Section 6.3. It is possible that new NAOMS operators may be able to use appeals and communication channels to potential participants that will achieve significantly greater participation than was accomplished during this brief test of the NAOMS web survey.

[1] These data are based on a review of NAOMS CATI operating experience during the September 2003 through August 2004 period when NAOMS operations were fully stabilized.

Other aspects of the web survey experiment had far more favorable outcomes. The invitees who did agree to participate were asked about their ability to efficiently navigate the survey document. The question asked was: "Please rate the following aspects of the NAOMS web survey on a scale of Excellent, Very good, Good, Fair, and Poor: Ease of navigation." Their responses are summarized in Figure 6-1. Ninety-three percent of the respondents reported their experiences as being excellent or very good.

Figure 6-1. Respondents' View of Ease of Navigation in Web Survey

The median time to complete the web survey was 31 minutes. This is similar to the average time required to complete the equivalent CATI survey. Seventy-nine percent of the respondents viewed this time burden as excellent or very good as shown in Figure 6-2. The question asked was: "Please rate the following aspects of the NAOMS web survey on a scale of Excellent, Very Good, Good, Fair, and Poor: Time to Complete."

Figure 6-2. Respondents' View of Time to Complete the Web Survey

The Section A flight activity data reported by web respondents were very similar to the equivalent data provided by CATI respondents. In particular, the average number of reported hours and legs flown for the two respondent groups was virtually identical. It did appear that the web survey achieved greater participation by pilots who worked for small carriers but less participation by pilots who flew all cargo flights. It was not practical to compare the Section B results for the web-based survey with those generated by the CATI survey because the web-based data set was far too small to generate statistically sound estimates for the large majority of Section B questions.

It was possible to compare the Section C JIMDAT results obtained via the web mode with those generated by CATI because the JIMDAT questions mainly related to non-rare events. We did comparisons for 66 Section C questions whose wording matched up exactly (or almost exactly) between the CATI and web-based survey variants. We used a chi-square testing procedure to determine whether it was possible to conclude, with an overall 80 percent or greater certainty, that the web-based answers followed a different distribution than those seen in the CATI data[2].

For 9 of the 66 questions, the distribution of responses was statistically distinct. For the remaining 57, the analysis procedure we used did not demonstrate a statistically significant difference in responses. These findings do not mean that no differences exist between the CATI and web data for these 57 questions. It does mean that whatever differences do exist for these questions, those differences are not large and obvious.

6.5. Transfer of Web-based Data Collection System

The trial of the web-based version of the NAOMS data collection system produced mixed results. The application itself worked well and most respondents liked its navigational approach, which was a major focus of the NAOMS web development effort. Where points of comparison could be made, the data collected via the web application seemed to match up reasonably well with that obtained through the CATI process. The major disappointment was

[2] For each question, we performed a likelihood ratio chi-squared test for significance in a cross-classification table to determine if there were significant differences between distribution of responses in the two instruments. In those cases where there were few observations in a category, we combined data from adjoining categories until a suitable number of responses was contained in each cell of the cross-classification table so that the underlying assumptions for the likelihood ratio chi-squared test were met. Because a large number of tests were conducted, a Bonferroni adjustment was used to control the overall error rate to be less than 20% (the corresponding per question error rate or alpha was 0.30%). Preserving the overall confidence level across the 66 comparisons required that the per-question confidence level be set to 99.7% using a Bonferroni multiple comparison adjustment.

the low response rate but it was possible that the new NAOMS operator, ALPA, might be able to stimulate additional participation through the promotional means available to it.

NASA collaborated within ALPA throughout FY06. NASA conducted training sessions for ALPA staff members on the NAOMS web application in early FY07 and conveyed the operational data collection system, and associated software licenses to ALPA in January of 2007.

7. Summary

The NAOMS project represented an ambitious effort to enrich the data available to U.S. aviation decision makers. To achieve its objectives, NAOMS needed to address and resolve a number of methodological issues related to content and structure of survey instruments; the selection of potential respondents; the length of the recall period used in the survey; and like matters.

NAOMS overcame each one of these methodological hurdles. It performed almost 30,000 survey interviews over a four-year period. The exceptional survey completion rates achieved by NAOMS affirm the quality of the survey design as well as NAOMS's effectiveness in enlisting the participation of the aviation community.

NAOMS, through its collaboration with the CAST-JIMDAT group, also demonstrated its ability to generate baseline measures that could be used in future years to gauge the effectiveness of safety interventions.

Government priorities shifted, and NASA concluded that the funds required by NAOMS operations were better spent on other priorities. In an effort to preserve a portion of the public investment in NAOMS, a streamlined web-based version of the data collection system was built, proved, and handed-off to the aviation industry. In this way, NAOMS will continue to support the national aviation safety mission.

8. Annotated Bibliography

The following bibliography contains a list of relevant sources (books, journals, periodicals, etc.) that were consulted by NAOMS researchers during the literature review phase. Some, but not all, of these sources are cited in the main body of this report.

Aguinis, H.; Pierce, C. A.; and Quigley, B. M. (1995). Enhancing the validity of self-reported alcohol and marijuana consumption using a bogus pipeline procedure: A meta-analytic review. Basic and Applied Social Psychology, 16, 515-527.

Allen, B. P. (1975). Social distance and admiration reactions of "unprejudiced" whites. Journal of Personality, 43, 709-726.

Anderson, B. A.; Silver, B. D.; and Abramson, P. R. (1988). The effects of the race of the interviewer on race-related attitudes of black respondents in SRC/CPS National Election Studies. Public Opinion Quarterly, 52, 289-324.

Anderson, J. R. (1976). Language, memory, and thought. Hillsdale, NJ: Erlbaum.

Aquilino, W. S. (1994). Interview mode effects in surveys of drug and alcohol use: A field experiment. Public Opinion Quarterly, 58, 210-240.

Aquilino, W. S., and Lo Sciuto, L. A. (1990). Effects of interview mode on self-reported drug use. Public Opinion Quarterly, 54, 363-395.

Arabie, P. and Carroll, J. D. (1980). MAPCLUS: A mathematical programming approach to fitting the ADCLUS model. Psychometrika, 45, 211-235.

Atkin, C. K., and Chaffee, S. H. (1972-73). Instrumental response strategies in opinion interview. Public Opinion Quarterly, 36, 69-79.

Barsalou, L. W. (1988). The content and organization of autobiographical memories. In U. Neisser, and E. Winograd (Eds.), Remembering reconsidered: Ecological and traditional approaches to the study of memory (pp. 193-243). New York: Cambridge University.

Baker, R. P.; Bradburn, N. M.; and Johnson, R. A. (1995). Computer-assisted personal interviewing: An experimental evaluation of data quality and cost. Journal of Official Statistics, 11, 413-431.

Becker, W. M. (1976). Biasing effect of respondents' identification on responses to a social desirability scale: A warning to researchers. Psychological Reports, 39, 756-758.

Begin, G.; Boivin, M.; and Bellerose, J. (1979). Sensitive data collection through the randomized response technique: Some improvements. Journal of Psychology, 101, 53-65.

Beldt, S. F.; Daniel, W. W.; and Garcha, B. S. (1982). The Takahasi-Sakasegawa randomized response technique: A field test. Sociological Methods and Research, 11, 101-111.

Benson, L. E. (1941). Studies in secret-ballot technique. Public Opinion Quarterly, 25, 79-82.

Bickart, B., and Felcher, E. M. (1996). Expanding and enhancing the use of verbal protocols in survey research. In N. Schwarz and S. Sudman (Eds.), Answering questions: Methodology for determining cognitive and communicative processes in survey research (pp. 115-142). San Francisco: Jossey-Bass.

Bishop, G. F., and Fisher, B. S. (1995). "Secret ballots" and self-reports in an exit-poll experiment. Public Opinion Quarterly, 59, 568-588.

Bishop, G. F.; Hippler, H. J.; Schwarz, N.; and Strack, F. (1988). A comparison of response effects in self-administered and telephone surveys. In R. M. Groves, P. P. Biemer, L. E. Lyberg, J. T. Massey, W. L. Nichols II, and J. Waksberg (Eds.), Telephone survey methodology (pp. 321-340). New York: Wiley.

Booth-Kewley, A.; Edwards, J. E.; and Rosenfeld, P. (1992). Impression management, social desirability, and computer administration of attitude questionnaires: Does the computer make a difference? Journal of Applied Psychology, 77, 562-566.

Brewer, K. R. W. (1981). Estimating marihuana usage using randomized response – some paradoxical findings. Australian Journal of Statistics, 23, 139-148.

Brewer, M. B.; Dull, V. T.; and Jobe, J. B. (1989). Social cognition approach to reporting chronic conditions in health surveys. Vital and health statistics. Series 6, No. 3 (DHHS publication no. PHS 89-1078). Washington, D.C.: U.S. Government Printing Office.

Brewer, M. B., and Lui, L. N. (1996). Use of sorting tasks to assess cognitive structures. In N. Schwarz and S. Sudman (Eds.), Answering questions: Methodology for determining cognitive and communicative processes in survey research (pp. 373-385). San Francisco: Jossey-Bass.

Buchman, T. A., and Tracy, J. A. (1982). Obtaining responses to sensitive questions: Conventional questionnaire versus randomized response technique. Journal of Accounting Research, 20, 263-271.

Calsyn, R. J.; Roades, L. A.; and Calsyn, D. S. (1992). Acquiescence in needs assessment studies of the elderly. The Gerontologist, 32, 246-252.

Campbell, B. A. (1981). Race-of-interviewer effects among southern adolescents. Public Opinion Quarterly, 45, 231-244.

Cantril, H. (1944). Gauging public opinion. New Jersey: Princeton University.

Carroll, J. D., and Arabie, P. (1983). INDCLUS: An individual differences generalization of the ADCLUS model and the MAPCLUS algorithm. Psychometrika, 48, 157-169.

Cohen, J., and Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences. Hillsdale, NJ: Erlbaum.

Collins, A. M., and Loftus, E. F. (1975). A spreading-activation theory of semantic processing. Psychological Review, 82, 407-428.

Colombotos, J. (1965). The effects of personal vs. telephone interviews on socially acceptable responses. Public Opinion Quarterly, 29, 457-458.

Cotter, P.; Cohen, J.; and Coulter, P. B. (1982). Race of interviewer effects in telephone interviews. Public Opinion Quarterly, 46, 278-294.

Davis, C., and Cowles, M. (1989). Automated psychological testing: Method of administration, need for approval, and measures of anxiety. Educational and Psychological Measurement, 49, 311-320.

DeLamater, J., and MacCorquodale, P. (1975). The effects of interview schedule variations on reported sexual behavior. Sociological Methods and Research, 4, 215-236.

De Leeuw, E. D., and van der Zouwen, J. (1988). Data quality in telephone and face to face surveys: A comparative meta-analysis. In R. M. Groves, P. P. Biemer, L. E. Lyberg, J. T. Massey, W. L. Nicholls II, and J. Waksberg (Eds.), Telephone survey methodology (pp. 283-299). New York: John Wiley.

DeNisi, A. S., and Peters, L. H. (1996). Organization of information in memory and the performance appraisal process: Evidence from the field. Journal of Applied Psychology, 81, 717-737.

DePaulo, B. M.; Kashy, D. A.; Kirkendol, S. E.; Wyer, M. M.; and Epstein, J. A. (1996). Lying in everyday life. Journal of Personality and Social Psychology, 70, 979-995.

Dillman, D. A. (1978). Mail and telephone surveys: The total design method. New York: Wiley.

Esaiasson, P., and Granberg, D. (1993). Hidden negativism: Evaluation of Swedish parties and their leaders under different survey methods. International Journal of Public Opinion Research, 5, 265-277.

Evan, W. M., and Miller, J. R., III. (1969). Differential effects on response bias of computer vs. conventional administration of a social science questionnaire: An exploratory methodological experiment. Behavioral Science, 14, 216-227.

Evans, R. I.; Hansen, W. B.; and Mittlemark, M. B. (1977). Increasing the validity of self-reports of smoking behavior in children. Journal of Applied Psychology, 62, 521-523.

Finkel, S. E.; Guterbock, T. M.; and Borg, M. J. (1991). Race-of-interviewer effects in a pre-election poll: Virginia 1989. Public Opinion Quarterly, 55, 313-330.

Fischer, R. P. (1946). Signed versus unsigned personal questionnaires. Journal of Applied Psychology, 30, 220-225.

Fidler, D. S., and Kleinknecht, R. E. (1977). Randomized response versus direct questioning: Two data-collection methods for sensitive information. Psychological Bulletin, 84, 1045-1049.

Fowler, F. J., Jr.; Roman, A. M.; and Di, Z. X. (1998). Mode effects in a survey of Medicare prostate surgery patients. Public Opinion Quarterly, 62, 29-46.

Franklin, L. A. (1989). Randomized response sampling from dichotomous populations with continuous randomization. Survey Methodology, 15, 225-235.

Gano-Phillips, S., and Fincham, F. D. (1992). Assessing marriage via telephone interviews and written questionnaires: A methodological note. Journal of Marriage and the Family, 54, 630-635.

Goffman, E. (1959). The presentation of self in everyday life. Garden City, NY: Doubleday/Anchor Books.

Goodstadt, M. S., and Gruson, V. (1975). The randomized response technique: A test on drug use. Journal of the American Statistical Association, 70, 814-818.

Gordon, R. A. (1987). Social desirability bias: A demonstration and technique for its reduction. Teaching of Psychology, 14, 40-42.

Groves, R. M. (1979). Actors and questions in telephone and personal interview surveys. Public Opinion Quarterly, 43, 191-205.

Hall, M. F. (1995). Patient satisfaction or acquiescence? Comparing mail and telephone survey results. Journal of Health Care Marketing, 15, 54-61.

Herzog, A. R., and Rodgers, W. L. (1988). Interviewing older adults: Mode comparison using data from a face-to-face survey and a telephone resurvey. Public Opinion Quarterly, 52, 84-99.

Himmelfarb, S., and Lickteig, C. (1982). Social desirability and the randomized response technique. Journal of Personality and Social Psychology, 43, 710-717.

Hinrichs, J. R., and Gatewood, R. D. (1967). Differences in opinion-survey response patterns as a function of different methods of survey administration. Journal of Applied Psychology, 51, 497-502.

Hochstim, J. R. (1967). A critical comparison of three strategies of collecting data from households. Journal of the American Statistical Association, 62, 976-989.

Horvitz, D. G.; Greenberg, B. G.; and Abernathy, J. R. (1976). Randomized response: A data-gathering device for sensitive questions. International Statistical Review, 44, 818-196.

Hough, K. S., and Allen, B. P. (1975). Is the "women's movement" erasing the mark of oppression from the female psyche? Journal of Personality, 89¸249-258.

Hutchison, J.; Tollefson, N.; and Wigington, H. (1987). Response bias in college freshmen's responses to mail surveys. Research in Higher Education, 26, 99-106.

Jobe, J. B.; Pratt, W. F.; Tourganeau, R.; Baldwin, A. K.; and Rasinski, K. A. (1997). Effects of interview mode on sensitive questions in a fertility survey. In L. E. Lyberg, P. P. Biemer, M. Collins, E. D. de Leeuw, C. Dippo, N. Schwarz, and D. Trewin (Eds.), Survey measurement and process quality (pp. 311-329). New York: John Wiley & Sons.

Jordan, L. A.; Marcus, A. C.; and Reeder, L. G. (1980). Response styles in telephone and household interviewing: A field experiment. Public Opinion Quarterly, 44, 210-222.

Kiesler, S., and Sproull, L. S. (1986). Response effects in the electronic survey. Public Opinion Quarterly, 50, 402-411.

Koson, D.; Kitchen, C.; Kochen, M.; and Stodolosky, D. (1970). Psychological testing by computer: Effect on response bias. Educational and Psychological Measurement, 30, 803-810.

Krosnick, J. A. (1991). Response strategies for coping with the cognitive demands of attitude measures in surveys. Applied Cognitive Psychology, 5, 213-236.

Krosnick, J. A., and Fabrigar, L. R. (forthcoming). Designing good questionnaires: Insights from psychology. New York: Oxford University Press.

Krosnick, J. A., and Green, M. C. (1998). The impact of interview mode on data quality in the National Election Studies. Unpublished memo to the Board of Overseers of the National Election Studies. Columbus, OH: The Ohio State University.

Krysan, M.; Schuman, H.; Scott, L. J.; and Beatty, P. (1994). Response rates and response content in mail versus face-to-face surveys. Public Opinion Quarterly, 58, 381-399.

Lautenschlager, G. J., and Flaherty, V. L. (1990). Computer administration of questions: More desirable or more social desirability? Journal of Applied Psychology, 75, 310-314.

Levin, J., and Montag, I. (1987). The effect of testing instructions for handling social desirability on the Eysenck personality questionnaire. Personality and Individual Differences, 8, 163-167.

Locander, W.; Sudman, S.; and Bradburn, N. (1976). An investigation of interview method, threat and response distortion. Journal of the American Statistical Association, 71, 269-275.

Martin, C. L., and Nagao, D. H. (1989). Some effects of computerized interviewing on job applicant responses. Journal of Applied Psychology, 74, 72-80.

McGeoch, J. A. (1942). The psychology of human learning. New York: Longmans, Green.

Mensink, G. J. M., and Raaijmakers, J. G. W. (1988). A model of interference and forgetting. Psychological Review, 95, 434-455.

Murray, D. M.; O'Connell, C. M.; Schmid, L. A.; and Perry, C. L. (1987). Addictive Behaviors, 12, 7-15.

Newton, R. R.; Prensky, D.; and Schuessler, K. (1982). Form effect in the measurement of feeling states. Social Science Research, 11, 301-317.

Nicholls, W. L., II; Baker, R. P.; and Martin, J. (1997). The effect of new data collection technologies on survey data quality. In L. E. Lyberg, P. P. Biemer, M. Collins, E. D. de Leeuw, C. Dippo, N. Schwarz, and D. Trewin (Eds.), Survey measurement and process quality (pp. 221-248). New York: John Wiley & Sons.

O'Reilly, J. M.; Hubbard, M. L.; Lessler, J. T.; Biemer, P. P.; and Turner, C. F. (1994). Audio and video computer assisted self interviewing: Preliminary test of new technologies for data collection. Journal of Official Statistics, 10, 197-214.

Ostrom, T. M.; Carpenter, S. L.; Sedikides, C.; and Li, F. (1993). Differential processing of in-group and out-group information. Journal of Personality and Social Psychology, 64, 21-34.

Paulhus, D. L. (1984). Two-component models of socially desirable responding. Journal of Personality and Social Psychology, 46, 598-609.

Pavlos, A. J. (1972). Racial attitude and stereotype change with bogus pipeline paradigm. Proceedings of the 80th Annual Convention of the American Psychological Association, 7, 292.

Pavlos, A. J. (1973). Acute self-esteem effects on racial attitudes measures by rating scale and bogus pipeline. Proceedings of the 81st Annual Convention of the American Psychological Association, 8, 165-166.

Potosky, D., and Bobko, P. (1997). Computer versus paper-and-pencil administration mode and response distortion in non-cognitive selection tests. Journal of Applied Psychology, 82, 293-299.

Pryor, J. B., and Ostrom, T. M. (1981). The cognitive organization of social information: A converging-operations approach. Journal of Personality and Social Psychology, 41, 628-641.

Quigley-Fernandez, B., and Tedeschi, J. T. (1978). The bogus pipeline as lie detector: Two validity studies. Journal of Personality and Social Psychology, 36, 247-256.

Raaijmakers, J. G. W., and Shiffrin, R. M. (1981). Search of associative memory. Psychological Review, 88, 93-134.

Reiser, B. J.; Black, J. B.; and Abelson, R. P. (1985). Knowledge structures in the organization and retrieval of autobiographical memories. Cognitive Psychology, 17, 89-137.

Roenker, D. L., Thompson, C. P., and Brown, S. C. (1971). Comparison of measures for the estimation of clustering in free recall. Psychological Bulletin, 76, 45-48.

Roese, N. J., and Jamieson, D. W. (1993). Twenty years of bogus pipeline research: A critical review and meta-analysis. Psychological Bulletin, 114, 363-375.

Rogers, T. F. (1976). Interviews by telephone and in person: Quality of responses and field performance. Public Opinion Quarterly, 40, 51-65.

Rosenstone, S. J.; Petrella, M.; and Kinder, D. R. (1993, June 21). Excessive reliance on telephone interviews and short-form questionnaires in the 1992 national election study: Assessing the consequences for data quality (NES Technical Report No. 43).

Rundus, D. (1973). Negative effects of using list items as recall cues. Journal of Verbal Learning and Verbal Behavior, 12, 43-50.

Schlenker, B. R., and Weigold, M. F. (1989). Goals and the self-identification process: Constructing desired identities. In L. A. Pervin (Ed.), Goal concepts in personality and social psychology (pp. 243-290). Hillsdale, NJ: Erlbaum.

Schober, M. F., and Conrad, F. G. (1997). Does conversational interviewing reduce survey measurement error? Public Opinion Quarterly, 61, 576-602.

Schuman, H., and Converse, J. M. (1971). The effect of black and white interviewers on black responses. Public Opinion Quarterly, 35, 44-68.

Sedikides, C., and Ostrom, T. M. (1988). Are person categories used when organizing information about unfamiliar sets of persons? Social Cognition, 6, 252-267.

Shimizu, I. M., and Bonham, G. S. (1978). Randomized response technique in a national survey. Journal of the American Statistical Association, 73, 35-39.

Siemiatycki, J. (1979). A comparison of mail, telephone, and home interview strategies for household health surveys. American Journal of Public Health, 69, 238-245.

Slamecka, N. J. (1968). An examination of trace storage in free recall. Journal of Experimental Psychology, 76, 504-513.

SPSS for Windows 8.0.0 [Computer software]. (1997). Chicago: SPSS, Inc.

Srull, T. K. (1983). Organizational and retrieval processes in person memory. Journal of Personality and Social Psychology, 44, 1157-1170.

StatSoft, Inc. (1997). STATISTICA for Windows [Computer program]. Tulsa, OK: StatSoft, Inc.

Sudman, S.; Bradburn, N. M.; and Schwarz, N. (1996). Thinking about answers: The application of cognitive processes to survey methodology. San Francisco: Jossey-Bass.

Tourangau, R.; Smith, T. W.; and Rasinski, K. A. (1997). Motivation to report sensitive behaviors on surveys: Evidence from a bogus pipeline experiment. Journal of Applied Social Psychology, 20, 209-222.

Tracy, P. E., and Fox, J. A. (1981). The validity of randomized response for sensitive measurements. American Sociological Review, 46, 187-200.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving, and W. Donaldson (Eds.), Organization of memory (pp. 381-403). New York: Academic Press.

Tversky, A., and Hutchinson, J. W. (1986). Nearest neighbor analysis of psychological spaces. Psychological Review, 93, 3-22.

Walker, A. H., and Restuccia, J. D. (1984). Obtaining information on patient satisfaction with hospital care: Mail versus telephone. Health Studies Research, 19, 291-306.

Walker, M. E. (1998) Standal: A program to format proximities and cluster memberships for performing stand-alone regression (Version 2.0) [Computer program]. Columbus, OH: The Ohio State University.

Warner, S. L. (1965). Randomized response: A survey technique for eliminating evasive answer bias. Journal of the American Statistical Association, 60, 63-69.

Weisberg, H. F.; Krosnick, J. A.; and Bowen, B. D. (1996). An introduction to survey research, polling, and data analysis. Thousand Oaks, CA: Sage.

Wiseman, F. (1972). Methodological bias in public opinion surveys. Public Opinion Quarterly, 36, 105-108.

Zdep, S. M., and Rhodes, I. N. (1976). Making the randomized response technique work. Public Opinion Quarterly, 40, 531-537.

Zdep, S. M.; Rhodes, I. N.; Schwarz, R. M.; and Kilkenny, M. J. (1979). The validity of randomized response technique. Public Opinion Quarterly, 43, 544-549.

Appendix 1: Contractor Research Team

Source: Battelle generated.

Appendix 1: Contractor Research Team

The following individuals were instrumental in planning, conducting, and analyzing research for the NAOMS program:

- Mr. Loren Rosenthal, NAOMS Program Manager
- Dr. Robert Dodd, NAOMS Principal Investigator
- Dr. Jon Krosnick, NAOMS Survey Methodologist
- Dr. Joan Cwi, NAOMS Survey Application Manager
- Dr. Tom Ferryman, NAOMS Senior Statistician
- Mr. Michael Silver, NAOMS Survey Methodologist
- Mr. J.M. Jobanek, NAOMS Aviation Safety Analyst
- Ms. Andrea Renholds, NAOMS Research Statistician
- Mr. Daniel Haber, NAOMS Research Scientist.

Appendix 2: Demographics

Prior to the field trial, an investigation was undertaken to determine the number and distribution of aviation operational personnel working in commercial aviation organizations within the United States. Included in this evaluation were pilots, air traffic controllers, flight attendants, mechanics, and dispatchers. This information was collected as background for the development of the NAOMS research project.

Sources included McGraw Hill World Aviation Directory (Winter 1999 edition), Aviation & Aerospace Almanac 2000, Federal Aviation Administration (FAA), Air Transport Association (ATA), Regional Airline Association (RAA), National Air Traffic Controllers Association (NATCA), Aircraft Owners and Pilots Association (AOPA), Air Line Pilots Association (ALPA), Association of Flight Attendants (AFA), National Business Aviation Association (NBAA), AFL-CIO, and the Teamsters. Individual aircraft operators were queried by telephone for missing data.

This appendix summarizes the key findings of the demographic survey.

Source: Battelle white paper prepared by Mr. Michael Jobanek and Dr. Robert Dodd, August 2000.

Distribution of Aviation Operational Personnel and Aircraft in the United States and Territories

MR. MICHAEL JOBANEK AND DR. ROBERT DODD

Ames Research Center

1. Introduction

An investigation was undertaken to determine the number and distribution of aviation operational personnel working in commercial aviation organizations within the United States. Included in this evaluation were pilots, air traffic controllers, flight attendants, mechanics, and dispatchers. This information was collected as background for the development of the National Aviation Operational Monitoring Service (NAOMS) research project sponsored by the National Aeronautics and Space Administration.

Information for this report was derived from the following sources: McGraw-Hill World Aviation Directory (Winter 1999 edition), The Aviation & Aerospace Almanac 2000, Federal Aviation Administration (FAA), Air Transport Association (ATA), Regional Airline Association (RAA), National Air Traffic Controllers Association (NATCA), Aircraft Owners and Pilots Association (AOPA), Air Line Pilots Association (ALPA), Association of Flight Attendants (AFA), National Business Aviation Association (NBAA), American Federation of Labor-Congress of Industrial Organizations (AFL-CIO), and the Teamsters. In addition, individual aircraft operators were also queried by telephone for missing data. Information developed from this investigation is summarized in the attached tables and appendices.

Every effort has been made to ensure that the information included in this technical memorandum is current; however, the accuracy of the information depends on the accuracy of the sources used to compile this report.

2. Findings

2.1 Operational Personnel

Pilots compose the largest group of aviation operational personnel. Mechanics and repairmen represent the second largest grouping, with approximately 33 percent of the total. Flight attendants, air traffic controllers, and dispatchers represent the smallest groups, with approximately 12 percent of the total when combined. Table 1 lists the distribution of these groups.

Each operational group has subgroups and distributions unique to its population. The balance of this paper describes these groups and their distributions in greater detail, as well as major aircraft operators and subgroups.

Table 1. Distribution of Aviation Operational Personnel

Groups	Total	% Total	Date of Reference*
Active Pilots	618,298	55.0	1998
Mechanics/Repairmen	365,484	32.4	1998
Flight Attendants	119,533	10.4	2000
Air Traffic Controllers	14,832	1.2	2000
Dispatchers	11,460	1.0	1999
Total	1,129,607	100.0	

* With many references, there is a lag between data collection and publication of those data.

2.1.1. Pilots and Operators

According to the FAA, there were 618,298 active pilots in the civil aviation community in 1998.[1] The types of pilot licenses (often called certificates) include the following: Student, Recreational, Private, Commercial, and Airline Transport Pilot.[2] Table 2 presents the distribution of pilots by the type of pilot certificate held.

Table 2. Distribution of Pilots by Age and Certificate Type†

Age	Total	Student	Recrea-tional	Private	Commercial*	ATP**	Rotorcraft Only**	Glider Only**	Flight Instructor***
14-15	220	220	0	0	0	0	0	0	0
16-19	14,087	10,495	3	3,234	243	0	32	80	57
20-24	36,205	13,427	5	13,430	8,523	313	304	203	4,359
25-29	54,300	13,799	13	16,480	17,122	5,688	904	294	11,516
30-34	68,330	12,964	13	22,866	15,133	15,460	1,289	605	10,462
35-39	82,494	12,914	34	32,006	13,679	21,578	1,241	1,042	9,536
40-44	86,772	10,829	38	39,048	13,464	20,536	1,065	1,792	9,260
45-49	83,012	8,101	30	36,590	14,227	21,144	1,159	1,761	9,590
50-54	70,017	5,265	35	29,929	14,397	18,417	630	1,344	8,594
55-59	48,794	2,994	25	21,060	10,448	13,205	219	843	5,788
60-64	33,362	1,809	17	15,547	8,734	6,538	60	657	4,235
65-69	24,054	1,296	32	13,378	5,982	2,543	41	782	2,573
70-74	13,697	572	16	7,382	4,433	1,274	15	5	1,540
74-79	5,522	188	3	2,416	2,258	652	2	3	818
80 and over	1,395	74	1	636	544	138	0	2	223
Totals	622,261	94,947	265	254,002	129,187	127,486	6,961	9,413	78,551
% of Total	100%	15.30%	0.04%	41%	21%	21%	1.10%	1.50%	14.40%

† Lampl, R., Editor. The Aviation & Aerospace Almanac Edition 2000, New York: McGraw-Hill.

* Includes pilots with an airplane only certificate; also includes those with an airplane and a helicopter and/or glider certificate.

** Glider pilots are not required to have a medical examination; however, totals above represent pilots who received a medical examination.

*** Not included in total active pilots, since a flight instructor rating is added to an existing pilot license.

1 A pilot needs a current medical certificate for his/her pilot license to be valid. It is estimated that there are more than two million individuals in the United States with pilot licenses, of which approximately 600,000 have current medical certificates. The presence of a valid medical certification likely indicates an active pilot.

2 U.S. Civil Airmen: Statistics pertaining to both pilot and non-pilot airmen were obtained from the official certification records (Civil Airmen Registry) maintained by the Airmen Certification and Medical Certification Branches of the FAA's Mike Monroney Aeronautical Center in Oklahoma City, OK.

Student Pilots – Requirements for a student pilot certificate are minimal. One must have a current FAA third-class medical certificate (good for 24 months before medical re-certification is required). The minimum age for obtaining a student pilot certificate is 14, but one cannot be certified by the FAA as a pilot until the age of 16. There is no time or upper-age limit for an individual taking flying lessons from an FAA-certified flight instructor (CFI).[3]

Recreational Pilots – A person must be at least 17 years of age to be eligible for a recreational pilot certificate. A recreational pilot may fly no more than one passenger in a light, single-engine aircraft fitted with four or fewer seats. In addition, a recreational pilot is restricted to flying in good-visibility conditions during daylight hours. A recreational pilot is also restricted from carrying passengers for hire and may fly no further than 50 miles from the home airport.[4]

Private Pilots – To obtain a private pilot certificate, one must be at least 17 years of age and hold a third-class medical certificate. In addition, one must pass an approved FAA ground and flight examination. A minimum of 40 hours of flight experience (with an instructor and as a solo student pilot) is required before a private pilot applicant can obtain his/her license. Private pilots may fly at night, carry more than one passenger, and fly in poor-visibility conditions if they are appropriately trained and have an instrument rating.[5] However, a private pilot certificate does not allow a pilot to carry passengers or cargo for hire.[6]

Commercial Pilots – To obtain a commercial pilot certificate, one must be at least 18 years of age, have a minimum of 250 hours of flight time, pass an FAA written examination and flight check, and hold a second-class medical certificate (requires medical re-certification every 12 months). An FAA commercial pilot certificate allows a pilot to carry passengers or cargo for hire and is the minimum certificate required to be hired as a pilot for an airline or air taxi service. An individual with a commercial certificate can serve as pilot in command (PIC) of an air taxi, but cannot serve as PIC of a commuter or air carrier aircraft operating under Part 121 of the Federal Aviation Regulations. An airline transport pilot (ATP) certificate is required under these regulations.[7] Commercial pilots who do not have an instrument rating are limited to flying passengers for hire only in good weather during the daytime.

Airline Transport Pilots – An ATP certificate is the highest pilot rating given by the FAA. Every PIC of a commercial aircraft operating under Parts 135 and 121 of the Federal Aviation Regulations is required to have an ATP rating. The applicant for an ATP rating must be at least 23 years of age

[3] Title 14, Code of Federal Regulations (CFR), Chapter I, Federal Aviation Regulations, Part 61, Subpart C, Student Pilots (1999), Washington, DC: U.S. Government Printing Office.

[4] Title 14, CFR, Chapter I, Federal Aviation Regulations, Part 61, Subpart D, Recreational Pilots (1999), Washington, DC: U.S. Government Printing Office.

[5] An instrument rating is added to private and commercial pilot certificates when a pilot has passed a written and practical examination that demonstrates that he/she has the ability to control the aircraft in poor-visibility conditions solely by reference to aircraft instrumentation. A pilot is required to have a private or commercial pilot certificate and at least 40 hours of actual or simulated experience flying solely by reference to instruments before he/she is eligible to obtain an instrument rating. Developing the skills required to control the aircraft by reference to instruments requires additional training. A pilot is required to pass a written, practical, and oral test to receive his/her instrument rating.

[6] Title 14, CFR, Chapter I, Federal Aviation Regulations, Part 61, Subpart E, Private Pilots (1999), Washington, DC: U.S. Government Printing Office.

[7] Title 14, CFR, Chapter I, Federal Aviation Regulations, Part 61, Subpart F, Commercial Pilots (1999), Washington, DC: U.S. Government Printing Office.

and hold both a commercial pilot certificate and an instrument rating. Total flight experience required for an ATP in a rotorcraft is 1200 flight hours, while 1500 hours are required for an ATP airplane rating. For the ATP pilot license to remain valid, a pilot is required to hold a first-class medical certificate (medical re-certification required every 6 months).[8]

Flight Instructors – To be eligible for a commercial flight instructor certificate (CFI), one must be at least 18 years of age, have a commercial pilot certificate, be instrument-rated, and pass an FAA written examination and an FAA flight check.[9]

2.1.2 Mechanics and Repairmen

There has been steady growth in the demand for FAA-certified airframe and power plant mechanics (A&P) as commercial aviation continues to expand. According to the FAA, in 1998, there were more than 365,484 FAA-certified mechanics and repairmen employed in the aerospace industry.[10]

An individual applying for an FAA Mechanic or Repairman license must be a minimum of 18 years of age. There is no stated retirement age. Many employers require a high school diploma, but it is not a requirement in order to take the FAA practical and written examinations required for Airframe and Power Plant or Repairman certification. The FAA requires either graduation from an FAA-approved maintenance training school or 18 months of practical experience working in aviation maintenance for eligibility to take the required FAA written and practical certification tests leading to certification.[11]

The airframe and engine manufacturers, together with the commercial air carriers, employ the largest number of aerospace workers. States on the West Coast and in New England have the most aerospace workers. Table 3 provides information on the distribution of mechanics and repairmen by FAA region.

The aerospace workers are highly unionized. More than 70 percent of FAA-certified mechanics and repairmen belong to a union. The Transport Workers Union and the International Association of Machinists are the primary unions representing these workers.

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[8] Title 14, CFR, Chapter I, Federal Aviation Regulations, Part 61, Subpart G, Airline Transport Pilots, (1999), Washington, DC: U.S. Government Printing Office.

[9] Title 14, CFR, Chapter I, Federal Aviation Regulations, Part 61, Subpart H, Flight Instructors, (1999), Washington, DC: U.S. Government Printing Office.

[10] FAA Civil Aeromedical Institute Registry of Non Airmen (1998), Oklahoma City: U.S. Government Printing Office.

[11] Title 14, CFR, Chapter I, Federal Aviation Regulations, Part 65, Subpart D, Mechanics and Subpart E, Repairmen (1999), Washington, DC: U.S. Government Printing Office.

Table 3. Distribution of Mechanics and Repairman by FAA Region*

Region	Mechanics	Repairmen
Alaska	3,530	565
Central	16,135	2,886
Eastern	43,652	4,745
Great Lakes	44,740	7,477
New England	12,179	2,654
Northwest Mountain	27,972	4,116
Southern	61,707	9,418
Southwest	47,966	7,889
Western Pacific	56,239	11,614
Region Total	314,120	51,364
Total Mechanics and Repairmen	365,484	

* FAA Civil Aero Medical Institute Registry of Certified Non Airmen (1998), Oklahoma City: U.S. Government Printing Office.

2.1.3 Flight Attendants

The FAA does not license flight attendants; therefore, there is no annual physical requirement as there is for pilots. However, an individual air carrier can require an annual physical for insurance or liability purposes. During initial training, flight attendant candidates must exhibit adequate physical strength to operate all emergency equipment in the aircraft cabin, including removal of over-wing emergency exit hatches.

The minimum age for employment as a flight attendant is 18. There is no mandatory retirement age, but most air carriers provide for retirement benefits at age 55. The airlines that employ the flight attendants (see Table 4) account for 99 percent of the revenue passenger miles flown in the United States.[12] The majority of flight attendants are represented by unions. Table 4 lists the distribution of flight attendants by airline and labor union.

Table 4. Distribution of Flight Attendants by Airline and Union†

Airline	Number of Flight Attendants	Union
Air Tran	636	Association of Flight Attendants
Air Wisconsin	277	Association of Flight Attendants
Alaska	1,859	Association of Flight Attendants
Allegheny Commuter	197	Association of Flight Attendants
Aloha	283	Association of Flight Attendants
America West	2,377	Association of Flight Attendants
American	21,050	Association of Professional Flight Attendants
American Eagle	1,268	Association of Flight Attendants
American Trans Air	1,522	Association of Flight Attendants
Atlantic Coast Airlines	268	Association of Flight Attendants
Atlantic Southeast	474	Association of Flight Attendants
Business Express	164	Association of Flight Attendants

[12] Association of Flight Attendants, Washington, DC.

Airline	Number of Flight Attendants	Union
CC Air	46	Association of Flight Attendants
Chelequin	40	Teamsters
Continental	8,500	International Association of Machinists
Continental Express	300	International Association of Machinists
Delta	19,000	None
Hawaiian	802	Association of Flight Attendants
Horizon Air	414	Association of Flight Attendants
Mesa	189	Association of Flight Attendants
Mesaba	587	Association of Flight Attendants
Midway	175	Association of Flight Attendants
Northwest	12,000	Teamsters
Pan American	67	Association of Flight Attendants
PSA	117	Association of Flight Attendants
Piedmont	200	Association of Flight Attendants
ProAir	62	Association of Flight Attendants
Southwest	5,300	Transport Workers Union
Tower	516	Association of Flight Attendants
TWA	4,200	International Association of Machinists
United	25,679	Associate of Flight Attendants
US Air Shuttle	201	Associate of Flight Attendants
US Airways	10,363	Associate of Flight Attendants
World Airways	400	Teamsters
Total:	119,533	

† Association of Flight Attendants, Washington, DC.

2.1.4 Air Traffic Controllers

Air traffic controllers are employed by the FAA and are assigned to the Air Traffic Services (ATS) division of the FAA. Of the 36,500 ATS employees, 14,832 are air traffic controllers. Engineers, technicians, pilots, flight inspection personnel, business managers, and support staff make up the remaining personnel. ATS has a myriad of responsibilities, including:

- Control of approximately 200,000+ daily takeoffs and landings
- Provision of 24 hours/day air traffic control services
- Management of the National Airspace System infrastructure through operation and maintenance of 32,500 facilities and systems
- Maintenance of 8,200 terminal instrument procedures and 9,000 airway segments
- Conduct of more than 11,000 flight inspections nationally and internationally each year to ensure the safety, quality, and reliability of the airspace system
- Assignment and protection of more than 40,000 aeronautical radio frequencies used in air traffic control and direction of the modernization of the NAS infrastructure.

Mandatory users of the ATC system include both civil and military aircraft operating under Instrument Flight Rules (IFR).[13] ATC advisory services are also provided to aircraft flying under

[13] Generally, IFR are required when visibility is less than 3 miles or when the base of the clouds is less than 1000 feet above the surface. When IFR procedures are in effect, aircraft receive traffic separation services from air traffic control. Under IFR, the pilots must receive and follow instructions from the controller on routing, altitude, and airspeed. VFR procedures can be used any time the weather conditions are greater than 3 miles' visibility and a 1000-foot cloud ceiling. Pilots flying under VFR are responsible for

visual flight rules (VFR) when the controller's workload permits and the pilot requests such services. Almost all airline flights and many general aviation flights operate under IFR, regardless of weather conditions. This means that an air traffic controller follows a flight from takeoff to landing and ensures that each aircraft is separated from other IFR traffic.

Once hired and assigned to an ATC facility, a trainee controller must complete certain requirements to be certified for all positions within a defined area. Generally, a new controller with no prior experience takes 2 to 5 years to become a fully qualified controller.

The National Air Traffic Controllers Association (NATCA) represents the controllers on pay and benefit issues. Table 5 provides the distribution of controllers by FAA region.

Table 5. Distribution of Air Traffic Controllers by Region

FAA Region	All Controllers*	NATCA Controllers†
Alaska	207	195
Central	709	578
Eastern	2,093	2,066
Great Lakes	2,869	2,352
New England	570	540
Northwest/Mountain	1,339	923
Southern	2,975	2,576
Southwest	2,009	1539
Western/Pacific	2,061	1,748
Total	14,832	12,517

* Federal Aviation Administration, Air Traffic Office of Resource Management, Washington, DC.
† National Air Traffic Controllers Association, Washington, DC.

2.1.5 Dispatchers

Aircraft flight dispatchers play an integral part in the safe initiation and completion of flight. The aircraft dispatcher works within an airline's operational control center to provide information on weather, routes to be flown, and other information to help ensure the safety of each assigned flight. The knowledge of the dispatcher is equal to that of the pilot in all areas of aeronautical expertise except that of actually flying the aircraft.

A candidate for a dispatcher's certificate from the FAA must be a minimum of 23 years of age. No physical is required for licensing.[14] Flight dispatchers are required to complete a rigorous academic program or have extensive flying experience for eligibility to take the FAA flight dispatcher's examination. This examination is very similar to the exam for an ATP rating, which is required for all pilots in command of an aircraft engaged in FAR 121 or 135 operations. The dispatcher must be familiar with aerodynamic limitations, such as aircraft takeoff weights, performance, fuel capacity, loading limitations, navigational aids, meteorology, communications, and a myriad of FAA regulations pertaining to his/her airline's operations. Federal Aviation Regulation Part 65 covers all licensing requirements for flight dispatchers. Upon successful completion of the dispatcher's examination, the candidate must take a practical examination,

their own traffic separation and, in most cases, do not need to communicate with controllers. Air carrier operations are required to be conducted under IFR procedures, regardless of the weather conditions.

[14] Title 14, CFR, Federal Aviation Regulations, Part 65, Certification of Airmen other than Flight Crewmembers, Subpart C, Aircraft Dispatchers (1999), Washington, DC: U.S. Government Printing Office.

which is given by an FAA inspector or a designated FAA examiner. There are approximately 11,460 FAA-certified dispatchers working today.[15]

The Airline Dispatcher Federation and the Transport Workers Union are the primary unions representing flight dispatchers. Dispatchers are highly organized, with more than 90 percent representation at the major and national air carriers. Table 6 provides the distribution of dispatchers by FAA region.

Table 6. Distribution of Aircraft Dispatchers by FAA Region*

FAA Region	Dispatchers
Alaskan	305
Central	202
Eastern	2,330
Great Lakes	1,757
New England	352
Northwest Mountain	681
Southern	2,704
Southwest	1,652
Western Pacific	1,477
Region Total	11,460

* Federal Aviation Administration Civil Aeromedical Institute Registry of Non Airmen (1998), Oklahoma City: U.S. Government Printing Office.

2.2 Aircraft Operators

2.2.1 Major Air Carriers

The major air carriers are defined as those with gross revenues of more than $1 billion per year. They account for the vast majority of the revenue passenger miles flown each year.[16] The major carriers operate approximately 3700 aircraft and employ more than 441,000 people, including 54,000 pilots.

Table 7. Major Air Carriers

Airline Name	Number of Employees	Number of Pilots	Number of Aircraft	Pilot Union or Association
Alaska Airlines	8,596	1,260	85	Air Line Pilots Association
America West Airlines	11,494	1,676	111	Air Line Pilots Association
American Airlines	87,190	9,600	672	Allied Pilots Association
Continental Airlines	34,982	4,097	435	International Association of Continental Pilots
Delta Airlines	68,889	9,495	562	Air Line Pilots Association
Northwest Airlines	47,998	6,305	415	Air Line Pilots Association
Southwest Airlines	27,675	3,400	288	Southwest Airline Pilots Association
TWA Airlines	24,008	2,443	190	Air Line Pilots Association
United Airlines	88,887	10,139	572	Air Line Pilots Association
US Airways	42,104	5,897	393	Air Line Pilots Association
Total	441,823	54,312	3,723	

[15] Airline Dispatchers Federation, Washington, DC.

[16] Air Line Pilots Association, Herndon, VA.
Lampl, R., Editor,.The Aviation & Aerospace Almanac 2000, New York: McGraw-Hill.
Weimer, Kent J., Editor. World Aviation Directory, Winter 1999, New York: McGraw-Hill.

2.2.2 National Air Carriers

The national carriers are defined as those with gross revenues between $100 million and $1 billion annually.[17] The national carriers operate approximately 998 aircraft and employ more than 56,000 personnel, including 9,281 pilots. Appendix 1 lists the national air carriers, along with their numbers of employees and aircraft.

2.2.3 Regional Air Carriers

Large regional air carriers have annual gross revenues between $10 million and $99.9 million. A medium regional is a carrier that has annual gross revenues of less than $10 million.[18]

Regional air carriers operate 1,781 aircraft and employ more than 40,000 personnel, including 13,323 pilots. These carriers operate smaller airplanes than the major and national airlines and are often referred to as commuter airlines. Appendix 2 lists the regional air carriers, along with their numbers of employees and aircraft.

2.2.4 Air Cargo Carriers

The air cargo carriers are a fast-growing segment of the commercial aviation industry.[19] Freight carriers employ approximately 292,000 personnel, including 14,106 pilots, and operate 1585 aircraft. Appendix 3 lists airlines that specialize in transporting freight.

2.2.5 Charter and Non-Scheduled Carriers

The charter and non-scheduled air services, which include air taxi and contract services, are normally small operations that provide on-demand air service to isolated communities around the country. They operate more than 2,000 aircraft and employ more than 17,000 personnel, including 7,179 pilots.[20] Appendix 4 lists non-scheduled and charter operators.

2.2.6 General Aviation

General aviation is the largest segment of the aviation industry. Although there is no legal definition of general aviation, it is commonly described as "all civil aviation except that carried out by the commercial airlines or the military." There are more than 183,000 active general aviation aircraft. This number represents 98 percent of the total aircraft in the United States.[21] General aviation also includes a variety of aircraft, including airplanes, helicopters, and gliders.

General aviation aircraft are used for a broad variety of purposes. According to the National Business Aviation Association, 5,000 U.S. companies have corporate flight departments operating

[17] Air Line Pilots Association, Herndon, VA.
Lampl, R., Editor, The Aviation & Aerospace Almanac 2000, New York: McGraw-Hill.
Weimer, Kent J., Editor. World Aviation Directory, Winter 1999, New York: McGraw-Hill.

[18] Air Line Pilots Association, Herndon, VA.
Weimer, Kent J., Editor, World Aviation Directory, Winter 1999, New York: McGraw-Hill.
Lampl, R., Editor. The Aviation & Aerospace Almanac 2000, New York: McGraw-Hill.

[19] Weimer, Kent J., Editor. World Aviation Directory, Winter 1999, New York: McGraw-Hill.

[20] Weimer, Kent J., World Aviation Directory Winter 1999, New York: McGraw-Hill.

[21] Federal Aviation Administration Statistical Handbook 1999, Washington, DC: U.S. Government Printing Office; Aircraft Owners and Pilots Association, Frederick, MD.

more than 10,000 aircraft and employing 20,000 pilots.[22] General aviation also includes, among others, private flying for pleasure and business, flight instruction, aerial application, aerial observation, photography, fire fighting, police traffic control, and pipeline/powerline surveillance. Table 8 provides the distribution of general aviation aircraft.[23]

Table 8. General Aviation Aircraft Distribution

Type of Operation	Number of Aircraft	Percent Total	Number of Hours Flown	Percent Total
Corporate	9,652	5.60	2,548,000	11.00
Business	25,554	14.90	3,055,000	13.00
Instructional	14,568	8.54	4,156,000	17.50
Personal	100,839	59.10	8,116,000	34.20
Aerial Application	4215	2.47	1,210,000	5.10
Aerial Observation	4936	2.90	1,750,000	7.40
External Load	133	0.08	172,000	0.75
Other Work	1214	0.71	226,000	0.95
Air Taxi	3927	2.30	1,670,000	7.10
Sightseeing	1336	0.78	323,000	1.40
Other	4226	2.48	640,000	0.30
Total	170,600		23,866,000	

2.2.7 Helicopter Air Service

Helicopters provide a variety of services, including air ambulance, pipeline and power line surveys, fire fighting, and police and media reporting. Commercial helicopter operators employ more than 5,000 personnel, including more than 1,700 pilots and operate 1,061 aircraft. Appendix 5 lists commercial helicopter operators.[24]

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[22] National Business Aviation Association Source Book on Aviation 1998, Washington, DC.

[23] U.S. Department of Transportation, the Federal Aviation Administration, the Aircraft Owners and Pilots Association and the National Business Aviation Association. (Both airplanes and helicopters are included in these summary statistics.)

[24] Lampl, R., Editor. The Aviation & Aerospace Almanac 2000, New York: McGraw-Hill.
Weimer, Kent J., Editor. World Aviation Directory, Winter 1999, New York: McGraw-Hill.

Appendix 1: National Airlines[25]

Airline	State	Number of Employees	Number of Pilots	Number of Aircraft
Air Tran	GA	3,500	380	37
Air Transport	FL	520	101	30
Air Wisconsin	WI	800	312	28
Aloha	HI	2,249	206	17
American Trans Air	IN	6,000	981	71
Atlantic Southeast	GA	2,762	756	88
Carnival	FL	1,220	234	22
Continental Express	FL	1,820	768	96
Continental Micronesia	GU	2,000	200	19
Hawaiian	HI	2,400	288	23
Horizon Air	CO	3,100	510	62
Mesa	AZ	1,450	1,134	183
Midway	IL	1,000	309	28
Midwest Express	WI	2,223	337	27
Reno Air	NV	2,500	286	30
Simmons	TX	4,400	840	86
Sun Country	AZ	2,010	208	19
Tower	NY	11,800	219	17
Trans States	CA	2,000	682	74
U.S. Airways Shuttle	VA	650	200	12
Western Pacific	CO	1,155	180	17
World	VA	725	150	12
Totals		56,284	9,281	998

25 Air Line Pilots Association, Herndon, VA.
Lampl, R., Editor. The Aviation & Aerospace Almanac 2000, New York: McGraw-Hill.
Weimer, Kent J., Editor. World Aviation Directory, Winter 1999, New York: McGraw-Hill.

Appendix 2: Regional Air Carriers[26]

Name	State	Number of Employees	Number of AC	Number of Pilots
Air Midwest/Mesa Air Group	KS	225	12	120
Air Nevada	NV	88	8	16
Air South	SC	550	7	80
Air Sunshine	FL	22	7	12
Alaska Island Air	AK	12	2	4
Alaska Juneau Aeronautics	AK	70	20	27
Allegheny	PA	1,200	41	400
Aloha Islandair	HI	230	6	60
Alpine	UT	55	12	30
American Eagle	CA	1,300	35	350
Arctic Circle Air Service	AK	31	4	20
Arctic Transportation Services	AK	65	15	12
Aspen Mountain Air	TX	250	8	80
Astral Aviation	WI	248	15	150
Atlantic Coast Airlines	VA	1,300	59	590
Atlantic Southeast Airlines	GA	2,762	82	820
Atlantic World Airways	FL	47	3	15
AVI	NV	125	11	50
Aviation Services Ltd./Freedom Air	GU	49	4	12
Baker Aviation	AK	32	5	10
Bemidji Aviation	MN	50	5	15
Bering Air	AK	85	4	16
Big Sky Airlines	MT	75	3	15
Business Express	NH	1,200	39	390
Cape Smythe Air Service	AK	105	8	20
Caribbean Int'l	PR	35	3	12
Casino Express	NV	102	2	15
CCAir	NC	600	26	260
Chautauqua Airlines	IN	320	30	180
Chicago Express	IL	100	10	50
Coastal Air Transport	VI	10	2	4
Colgan Air	VA	140	6	60
Comair Inc.	OH	3,000	96	960
Commutair	NY	340	30	150
Conquest Airlines	TX	141	8	48
Continental Express	TX	1,820	106	1,000
Corporate Air	MT	320	82	109
Corporate Express	TN	150	8	60
East Coast Aviation Services/ Executive Airlines	NY	43	3	18
Eastwind Airlines	NC	120	2	20
Empire Airlines	ID	250	48	60
ERA Aviation	AK	160	87	120
Executive Airlines	PR	1,446	18	180
Express Airlines 1	GA	900	58	500
Flagship Airline	TN	2,126	68	680
Flamenco Airways	PR	65	4	20
Flying Boat Inc/Pan Am Air Bridge	FL	45	5	20
40 Mile Air	AK	25	4	6
Frontier Airlines	CO	700	10	100
Frontier Flying Service	AK	85	4	30

[26] Air Line Pilots Association, Herndon, VA.
Lampl, R., Editor. The Aviation & Aerospace Almanac 2000, New York: McGraw-Hill.
Weimer, Kent J., Editor. World Aviation Directory, Winter 1999, New York: McGraw-Hill.

Name	State	Number of Employees	Number of AC	Number of Pilots
Grand Canyon Airlines	AZ	40	5	25
Great Lakes Airlines	IA	1,400	57	560
Gulfstream Int'l Airlines	FL	500	23	200
Haines Airways	AK	40	7	7
Hyannis Air Service	MA	200	5	50
Island Airlines	MA	53	2	4
Jettrain	PA	120	2	20
Jib/Action Airlines	CT	11	2	4
Kenmore Air Harbor	WA	65	7	30
Ketchikan Air Service	AK	75	3	10
LAB Flying Service	AK	75	2	6
Laker Airways	FL	175	4	40
Larry's Flying Service	AK	60	2	15
Las Vegas Airlines	NV	28	2	8
Mahalo Air	HI	300	7	70
Mesa Air Group	NM	2,500	100	1,134
Mesaba Aviation	MN	1,800	74	750
Mission Aviation Fellowship	CA	295	6	60
Nations Air Express	GA	102	3	30
New England Airlines	RI	15	2	8
Olson & Sons	AK	29	3	10
Pacific Island Aviation	MP	130	7	50
Pan American World Airways	FL	600	4	60
Paradise Island Airlines	FL	125	5	40
Peninsula Airways	AK	350	16	40
Pennsylvania Aviation	PA	50	2	10
Piedmont Airlines/Sub US Airways	MD	1,750	49	490
Planet Airways	FL	10	1	6
Prestige Airways	VA	150	5	50
Proair	WA	175	2	20
PSA Airlines	OH	900	25	250
Redwing Airways	MO	7	6	5
Reeve Aleutian Airways	AK	240	5	40
Rich Int'l Airways	FL	1,100	10	100
Samoa Aviation	AS	65	3	15
Skagway Air Service	AK	10	12	10
Skywest Airlines	UT	2,100	69	690
Southcentral Air	AK	28	7	10
Spirit Airlines	MI	400	13	130
Springdale Air Service	AR	24	23	18
Sunshine Airlines	CA	18	7	12
Tanana Air Service	AK	14	8	8
Tatonduk Outfitters	AK	28	5	18
Trans Air	HI	52	5	14
Tristar Airlines	NV	165	1	8
UFS	MO	400	9	90
Vanguard Airlines	MO	568	8	80
Vieques Air Link	VI	53	2	10
Village Aviation	AK	50	8	7
Virgin Air/Air St. Thomas	VI	22	4	8
West Isle Air	WA	26	4	7
Wright Air Service	AK	25	2	6
Yute Air Alaska	AK	180	1	4
Totals		40,917	1,781	13,323

Appendix 3: Cargo Only Airlines[27]

Name	State	Number of Employees	Number of Pilots	Number of Aircraft
ABX Air/Airborne Express	OH	6,800	1,100	109
Air Cargo Carriers	WI	140	60	19
AirPac Airlines	WA	30	6	2
American Int'l Airways	MI	3,000	300	54
Ameriflight	CA	550	120	83
Amerijet	FL	512	150	16
Atlas Air	NY	610	676	22
BankAir	SC	85	40	30
Bax Global	CA	630	407	37
BigHorn Airways	WY	16	6	4
Burlington Air Express	CA	6,300	250	18
Business Air Inc.	VT	40	21	13
Capital Cargo Int'l Airlines	FL	21	6	2
Challenge Air Cargo	FL	800	30	4
Custom Air Transport	FL	90	20	5
DHL Airways	CA	10,000	487	33
Emery Worldwide	CA	10,020	454	62
Evergreen Int'l	OR	475	295	20
Express One Int'l	TX	455	258	27
Federal Express	TN	145,000	5,833	505
Fine Airlines	FL	1,000	120	15
Florida West Int'l Airways	FL	71	11	2
Gemini Air Cargo	DC	250	90	6
IFL Group (Corporate Express)	MI	51	18	8
Kitty Hawk Air Cargo	TX	500	300	46
Merlin Express	TX	130	64	38
Mid-Atlantic Freight	NC	120	35	20
Million Air	FL	150	27	5
Mountain Air Cargo	NC	280	120	69
Northern Air Cargo	AK	220	70	14
Polar Air Cagro	CA	600	184	13
Regional Express	ID	175	12	7
Relient Airlines	MI	150	36	14
Renown Aviation	CA	115	30	5
Suburban Air Freight	NE	60	30	6
UPS Airlines	KY	103,000	2,321	193
USA Jet Airlines Inc.	MI	320	75	25
Westair Inc.	CA	60	44	34
Totals		292,826	14,106	1,585

[27] Air Line Pilots Association, Herndon, VA.
Lampl, R., Editor. The Aviation & Aerospace Almanac 2000, New York: McGraw-Hill.
Weimer, Kent J., Editor. World Aviation Directory, Winter 1999, New York: McGraw-Hill.

Appendix 4: Charter and Non-Scheduled Carriers[28]

Name	State	Number of Employees	Number of AC	Number of Pilots
A&M Aviation/CNS	IL	15	12	24
Aberdeen Flying Service	SD	8	1	2
Ace Aerial Service/CNS	CA	3	10	20
ACM Aviation/CNS	CA	40	9	20
Action Airlines/CNS	CT	36	8	16
Adirondack Flying Service/CNS	NY	8	6	8
Aero Air/CNS	OR	75	4	6
Aero Freight/dba Aero Executive/CNS	TX	20	8	16
Aero Tech Flight Service/CNS	AK	30	17	25
Aeroflite/CNS	IL	15	5	10
Agile Air Service/CNS	NH	5	2	6
Air Alpha/CNS	OH	5	1	3
Air America/CNS	MI	15	4	5
Air Cargo Carriers	WI	92	10	25
Air Carriage/CNS	CA	5	4	10
Air Charter of Virginia/CNS	VA	14	5	10
Air Charter Service/CNS	PA	12	3	8
Air Midway/CNS	NE	5	3	4
Air Molokai	HI	30	3	6
Air Nevada Airlines	NV	88	11	33
Air San Luis/CNS	CA	18	4	8
Air Service Int'l/CNS	CA	90	14	22
Air Trek/CNS	FL	12	2	3
Airmotive Enterprises Inc./CNS	MN	10	4	6
Airspect Inc./CNS	OH	5	6	4
Airstar Int'l Airlines/CNS	FL	13	1	4
Alexander Aviation Inc./CNS	MN	5	8	25
Alpine Air Charter/CNS	IL	5	1	2
American Flag Airlines, Inc./CNS	FL	7	2	4
American Flight Services/CNS	DC	12	8	12
Ameristar Jet Charter, Inc/CNS	TX	45	4	18
Archway Aviation Inc./CNS	MO	10	8	6
Aroostook Aviation Inc./CNS	ME	15	4	6
Atlantic Aviation Flight Service Inc./CNS	NJ	35	8	16
Aviation Methods, Inc./NS	CA	300	50	225
Aviation Resources Ltd./Valley Aircraft/CNS	ND	45	7	25
Aviex Jet, Inc./CNS	TX	24	10	12
Baron Enterprises/CNS	OH	12	7	7
Basco Flying Service Inc./CNS	PA	16	9	9
Basler Airlines/CNS	WI	32	7	7
Bay Air Flying Service/CNS	FL	30	4	4
Beaver Aviation Services Inc./CNS	PA	80	3	3
BeckAir Co. Inc./CNS	IN	8	2	2
Bird Air Fleet, Inc./CNS	NH	16	7	7
Blackhawk Air Service/CNS	IL	7	4	4
Bluffton Flying Service Co./CNS	OH	8	10	4
Bowman Aviation Inc./CNS	IN	125	10	6
Bridgeford Flying Service/CNS	CA	30	25	20
Brooks Seaplane Service/CNS	ID	13	1	2
Bullock Charter Inc./CNS	MA	5	1	2

[28] Lampl, R., Editor. The Aviation & Aerospace Almanac 2000, New York: McGraw-Hill.
Weimer, Kent J., Editor. World Aviation Directory, Winter 1999, New York: McGraw Hill.

Name	State	Number of Employees	Number of AC	Number of Pilots
Bun Air Corp./CNS	PA	11	8	8
Business Jetsolutions/CNS	TX	250	14	25
Capital Aviation Corp./CNS	ND	6	5	5
Casper Air Service/CNS	WY	60	10	20
Central Air Service/CNS	MT	3	5	3
Central Air Southwest/CNS	OK	25	4	8
Champion Air/CNS	MN	200	6	30
Channel Islands Aviation/CNS	CA	30	19	22
Charter Jet Int'l/CNS	CO	42	4	10
Chester Country Aviation/CNS	PA	36	3	5
Cheyenne Charter Inc./CNS	IN	7	3	3
Clay Lacy Aviation/CNS	CA	58	12	24
Clintondale Aviation/CNS	NY	75	3	10
Coastal Air Services/CNS	CT	15	11	12
Commercial Aviation Corp./CNS	OH	16	9	8
Condor Enterprise Inc./CNS	IL	8	2	4
Consolated Airways Inc./CNS	IN	11	3	6
Corporate Jets, Inc./CNS	PA	700	35	140
Croporate Airways/CNS	FL	10	7	7
Crossings Aviation/CSN	WA	30	6	14
Crossjet, Inc./CNS	DC	6	2	2
Davisair, Inc./CNS	PA	20	6	14
Deland Aviation/CNS	FL	10	11	4
Denison Aviation, Inc./CSN	IA	7	7	3
Dodson Int'l Air/CNS	GA	22	8	11
Don Davis Aviation/CNS	KY	18	5	6
Downeast Flying Service/CNS	ME	10	1	2
EL Aero Services/CNS	NV	4	13	3
Elmira Aeronautical Corp/CNS	NY	20	1	3
Encore Int'l Airways/CNS	WA	16	2	4
Executive Flight/CNS	WA	10	3	5
Executive Fliteways, Inc./CNS	NY	25	11	15
F.I.T. Aviation/CNS	FL	15	43	10
Falcon Aviation/CNS	SD	6	8	5
Falwell Aviation/CNS	VA	20	7	10
Flight Int'l/CNS	VA	125	21	84
Flight One Inc./CNS	MI	11	3	6
FlightStar Corp./CNS	IL	55	5	20
Gibson Aviation/CNS	MD	12	4	6
Global Air Charter/CNS	FL	65	6	30
Grand Aire Express/CNS	MI	170	24	100
Gunnison Valley Aviation/CNS	CO	10	5	6
Hansen Flying Service/CNS	MI	16	6	8
Hart Enterprises/CNS	ID	7	3	3
Havre Flying Service/CNS	MT	5	1	2
Holman's Transportation Systems/CNS	AL	4	1	2
Hutcherson Air Service/CNS	TX	10	5	5
Iliamna Air Taxi/CNS	AK	12	11	7
International Aviation/CNS	FL	73	5	36
Int'l Jet Aviation Services/CNS	CO	32	12	25
Island Air Charters/CNS	FL	5	3	3
Jaax Flying Service/CNS	CA	3	3	2
Jackson Hole Aviation/CNS	WY	24	5	12
Jet Aviation Int'l/CNS	FL	424	47	225
Jet Charter Inc./CNS	NJ	10	4	4
Jet East, Inc./CNS	TX	86	4	24
Jet Services/CNS	NJ	18	1	4

Name	State	Number of Employees	Number of AC	Number of Pilots
Jim Air/CNS	AK	8	4	4
Kaiser Air Inc./CNS	CA	130	3	20
Katmai Air/CNS	AK	15	7	6
Kenai Air/CNS	AK	2	4	1
Lake Mead Air/CNS	NV	13	23	10
Lakeland Aviation Co./CNS	WI	7	1	2
Lane Aviation/CNS	OH	162	4	30
Logan & Reavis Air/CNS	OR	9	5	5
Lumanair/CNS	IL	35	2	8
Lynch Flying Service/CNS	MT	55	22	25
Lynstar Aviation/CNS	NJ	30	3	15
Magnus Aviation/CNS	WI	32	6	20
Martin Aviation/CNS	CA	70	10	45
Mayo Aviation/CNS	CO	50	14	28
Meeker Airport/CNS	CO	3	4	2
Miami Air Int'l/CNS	FL	329	5	55
Mid-Coast Air Charter/CNS	TX	10	4	6
Midstate Aviation/CNS	WA	25	15	18
Miller Flying Service/CNS	TX	18	2	6
Mobile Air Center/CNS	AL	45	4	6
Monterey Airplane Co./CNS	CA	9	3	3
Mountain Air Services/CNS	ME	3	7	2
Mountain Bird Inc./CNS	ID	12	9	7
National Jets/CNS	FL	60	7	30
Navajo Aviation/CNS	CA	45	5	20
New Mexico Flying Service/CNS	NM	20	16	10
North American Airlines/CNS	NY	160	3	30
Omni Air Express/CNS	OK	50	3	30
Orco Aviation/CNS	CA	25	4	5
PAB Aviation/CNS	PA	20	3	3
Pacific Flights/CNS	OR	17	4	7
Panama Aviation/CNS	FL	8	5	4
Pensacola Aviation Center/CNS	FL	49	12	15
Phoenix Air/CNS	GA	140	23	98
Prime Airborne/CNS	NY	10	7	6
Pro-Flite of Vero/CNS	FL	54	31	38
Pronghorn Aviation/CNS	CA	3	2	1
Redtail Aviation/CNS	UT	7	9	5
Rhoades Aviation/CNS	IN	65	22	44
Richmor Aviation/CNS	NY	180	20	100
Ross Aviation/CNS	NM	126	6	65
RSVP Jet/CNS	CA	4	1	2
Ryan Int'l Airlines/CNS	KS	698	41	410
Scenic Airlines/CNS-Sub Sky West	AZ	45	22	30
Schaefer Air Service/CNS	CA	250	3	20
Seneca Flight Operations/CNS	NY	22	6	12
Servair/CNS	ND	8	8	6
Sierra Nevada Airways/CNS	NV	18	4	12
Sierra Pacific Airlines/CNS	AZ	30	1	15
Silver Ranch Airpark/CNS	NH	5	2	2
Sky Aviation/CNS	WY	5	7	6
Skybird Aviation/CNS	CA	6	1	2
Southeast Airmotive/CNS	NC	25	15	17
Southwest Aviation/CNS/Midwest Aviation	MN	10	6	5
Sportsflight Airways/CNS	AZ	125	1	15
Star Airlines/CNS	OH	30	2	10
Star Aviation/CNS	SD	9	4	4

Name	State	Number of Employees	Number of AC	Number of Pilots
Sternair/CNS	TX	20	6	8
Sugarpine Aviatiors/CNS	CA	3	2	2
Summit Aviation/CNS	NT	20	3	12
Sun Pacific Int'l/CNS	AZ	50	2	24
Sunbird Aviation/CNS	MT	20	8	14
Sundance Helicopter/CNS	NV	32	11	12
Superior Aviation/CNS	MI	80	21	38
T.S.P.I./CNS	OK	25	10	15
Taft Air/CNS	NJ	10	3	4
Taquan Air Service/CNS	AK	21	3	12
Telford Aviation/CNS	ME	50	16	37
Thunderbird Airways/CNS	TX	7	12	5
Towle Enterprises/CNS/Twin Air Service	Ffl	30	4	8
Trans Northern Airways/CNS	FL	25	10	15
Trans-Florida Airlines/CNS	FL	19	5	6
Transit Aviation of Lake Charles/CNS	LA	28	7	14
Tri-Star Aviation/CNS	VA	4	4	3
Tulip City Air Service/CNS	MI	38	5	10
Umiat Enterprises/CNS	AK	7	3	2
Universal Airways/CNS	TX	10	2	2
Vee Neal Aviation/CNS	PA	10	14	8
Victoria Aviation Services/CNS	TX	15	8	8
Viscount Air Services/CNS	AZ	250	4	60
Ward Air/CNS	AK	10	4	6
Wayfarer Aviation/CNS	NY	60	15	30
West Coast Air Charter/CNS	TX	9	4	3
Weyerhaeuser Co. Aviation/CNS	WA	80	16	49
Wiggins Airways/CNS	MA	105	35	70
Wild Blue Yonder/CNS	ID	7	4	6
World Aircraft/Spares Corp./CNS	FL	18	22	15
Wren Air/CNS	AK	7	3	5
Totals		9,004	1,566	3,713

Appendix 5: Commercial Helicopter Services[29]

Helicopter Air Service	State	Number of# Employees	Number of AC	Number of Pilots
Advance Life Support Emergency Rescue Team	MT	4	1	3
Aero-Copters Inc.	WA	6	3	4
Air Logistics of Alaska	AK	44	14	20
Air Methods	CO	250	34	130
Aircoastal Helicopters	FL	6	5	5
Allied Helicopter Service	OK	8	11	5
Arctic Air Service	AK	12	3	4
Arrowhead Helicopters	AZ	2	1	2
Astrocopters	CA	8	5	5
Aviation Services Unlimited	NY	6	2	3
Joe Brigham	NH	5	5	5
Cane Air	LA	5	1	3
Carson Services	PA	75	6	12
Cascade Helicopters	WA	22	9	10
Central Helicopters	MT	5	1	2
Classic Helicopter Corp.	WA	13	10	10
Columbia Helicopters	OR	800	40	70
Crew Concepts	ID	5	3	3
Diamondback Aviation Services	AZ	10	3	5
ERA Helicopters	AK	485	90	110
Erickson Air Crane	OR	60	16	20
Evergreen Helicopters	OR	140	63	80
Evergreen Helicopters of Alaska	AK	9	5	6
Falcon Helicopters	CO	4	3	3
Fetsko Aviation Sales & Transportation	PA	6	2	3
Fly Wright Corp.	WA	5	3	4
Fostaire Helicopters	IL	10	8	6
Geo-Seis Helicopters	CO	75	26	33
Heli-Cab Helicopter Services	TX	5	1	3
Helicopter Consultants of Maui	HI	98	13	20
Helicopter Minit Men	OH	20	4	6
Helicopter Services Inc.	TX	12	13	10
Helicopters Inc.	IL	60	37	43
Heliflight	FL	15	12	13
Heli-Jet Corp.	OR	25	7	12
Helinet Corp.	CA	18	6	9
Helistream Inc.	CA	16	11	11
High Tech Applications	WV	6	2	3
Hillsboro Aviation	OR	65	27	30
Horizon Helicopters	CA	10	3	5
Houston Helicopters	TX	38	29	25
Industrial Helicopters	LA	60	14	20
Interstate Helicopters	OK	3	3	3
Keystone Flight Services	PA	71	18	25
Landells Aviation	CA	8	4	5
Liberty Helicopters	NJ	45	11	14
Maritime Helicopters	AK	9	3	5
McMahon Helicopter Services	MI	12	8	9
Metro Aviation	LA	85	21	25
Metropolitan Helicopter Services	NJ	4	1	2

[29] Lampl, R., Editor. The Aviation & Aerospace Almanac 2000, New York: McGraw-Hill.
Weimer, Kent J., Editor. World Aviation Directory, Winter 1999, New York: McGraw-Hill.

Helicopter Air Service	State	Number of# Employees	Number of AC	Number of Pilots
Mid Valley Helicopters	OR	5	4	4
Midwest Helicopter Airways	IL	15	4	6
Miller-Crestar Helicopters	PA	2	2	2
National Helicopter Service & Engineering Co.	CA	14	10	12
New England Helicopter	NY	2	2	2
New York Helicopter	NY	150	4	20
Norcross Helicopter	NY	5	3	3
Papillon Grand Canyon Helicopters	WA	100	20	30
Petroleum Helicopters	LA	1,850	242	642
Redding Air Service	CA	10	4	6
Reforestation Services Inc.	OR	18	1	4
Rogers Helicopters	CA	25	23	23
Royale Helicopter Service	PA	3	3	3
Sacramento Executive Helicopters Inc.	CA	15	4	6
St. Louis Helicopter Airways	MO	70	17	25
Salaika Aviation	TX	15	4	8
San Joaquin Helicopters	CA	90	19	25
Shier Aviation	CA	6	6	6
Sky Helicopters	TX	4	5	4
Skyhawk Helicopter Service	UT	5	2	4
South Sea Helicopter Corp.	HI	25	3	9
Southeast Mississippi Air Ambulance District	MS	7	1	3
Suncoast Helicopters	FL	15	9	12
U.S. Helicopters Inc.	NC	22	17	18
Versatile Helicopters Inc.	OK	9	8	8
West Florida Helicopters Inc.	FL	9	2	3
Western Helicopter Services	OR	15	8	8
Whirl-Away Helicopters Inc.	IN	10	5	5
Wolfe Air Aviation	CA	6	5	5
Zebra Air Inc.	TX	4	3	3
Totals		5,291	1,061	1,773

Appendix 3: Annotated Bibliography

Source: Battelle generated.

Appendix 3: Annotated Bibliography

The following bibliography contains a list of relevant sources (books, journals, periodicals, etc.) that were consulted by NAOMS researchers during the literature review phase. Some, but not all, of these sources are cited in the main body of this report.

Aguinis, H.; Pierce, C. A.; and Quigley, B. M. (1995). Enhancing the validity of self-reported alcohol and marijuana consumption using a bogus pipeline procedure: A meta-analytic review. Basic and Applied Social Psychology, 16, 515-527.

Allen, B. P. (1975). Social distance and admiration reactions of “unprejudiced” whites. Journal of Personality, 43, 709-726.

Anderson, B. A.; Silver, B. D.; and Abramson, P. R. (1988). The effects of the race of the interviewer on race-related attitudes of black respondents in SRC/CPS National Election Studies. Public Opinion Quarterly, 52, 289-324.

Anderson, J. R. (1976). Language, memory, and thought. Hillsdale, NJ: Erlbaum.

Aquilino, W. S. (1994). Interview mode effects in surveys of drug and alcohol use: A field experiment. Public Opinion Quarterly, 58, 210-240.

Aquilino, W. S., and Lo Sciuto, L. A. (1990). Effects of interview mode on self-reported drug use. Public Opinion Quarterly, 54, 363-395.

Arabie, P. and Carroll, J. D. (1980). MAPCLUS: A mathematical programming approach to fitting the ADCLUS model. Psychometrika, 45, 211-235.

Atkin, C. K., and Chaffee, S. H. (1972-73). Instrumental response strategies in opinion interview. Public Opinion Quarterly, 36, 69-79.

Barsalou, L. W. (1988). The content and organization of autobiographical memories. In U. Neisser, and E. Winograd (Eds.), Remembering reconsidered: Ecological and traditional approaches to the study of memory (pp. 193-243). New York: Cambridge University.

Baker, R. P.; Bradburn, N. M.; and Johnson, R. A. (1995). Computer-assisted personal interviewing: An experimental evaluation of data quality and cost. Journal of Official Statistics, 11, 413-431.

Becker, W. M. (1976). Biasing effect of respondents’ identification on responses to a social desirability scale: A warning to researchers. Psychological Reports, 39, 756-758.

Begin, G.; Boivin, M.; and Bellerose, J. (1979). Sensitive data collection through the randomized response technique: Some improvements. Journal of Psychology, 101, 53-65.

Beldt, S. F.; Daniel, W. W.; and Garcha, B. S. (1982). The Takahasi-Sakasegawa randomized response technique: A field test. Sociological Methods and Research, 11, 101-111.

Benson, L. E. (1941). Studies in secret-ballot technique. Public Opinion Quarterly, 25, 79-82.

Bickart, B., and Felcher, E. M. (1996). Expanding and enhancing the use of verbal protocols in survey research. In N. Schwarz and S. Sudman (Eds.), Answering questions: Methodology for determining cognitive and communicative processes in survey research (pp. 115-142). San Francisco: Jossey-Bass.

Bishop, G. F., and Fisher, B. S. (1995). "Secret ballots" and self-reports in an exit-poll experiment. Public Opinion Quarterly, 59, 568-588.

Bishop, G. F.; Hippler, H. J.; Schwarz, N.; and Strack, F. (1988). A comparison of response effects in self-administered and telephone surveys. In R. M. Groves, P. P. Biemer, L. E. Lyberg, J. T. Massey, W. L. Nichols II, and J. Waksberg (Eds.), Telephone survey methodology (pp. 321-340). New York: Wiley.

Booth-Kewley, A.; Edwards, J. E.; and Rosenfeld, P. (1992). Impression management, social desirability, and computer administration of attitude questionnaires: Does the computer make a difference? Journal of Applied Psychology, 77, 562-566.

Brewer, K. R. W. (1981). Estimating marihuana usage using randomized response – some paradoxical findings. Australian Journal of Statistics, 23, 139-148.

Brewer, M. B.; Dull, V. T.; and Jobe, J. B. (1989). Social cognition approach to reporting chronic conditions in health surveys. Vital and health statistics. Series 6, No. 3 (DHHS publication no. PHS 89-1078). Washington, D.C.: U.S. Government Printing Office.

Brewer, M. B., and Lui, L. N. (1996). Use of sorting tasks to assess cognitive structures. In N. Schwarz and S. Sudman (Eds.), Answering questions: Methodology for determining cognitive and communicative processes in survey research (pp. 373-385). San Francisco: Jossey-Bass.

Buchman, T. A., and Tracy, J. A. (1982). Obtaining responses to sensitive questions: Conventional questionnaire versus randomized response technique. Journal of Accounting Research, 20, 263-271.

Calsyn, R. J.; Roades, L. A.; and Calsyn, D. S. (1992). Acquiescence in needs assessment studies of the elderly. The Gerontologist, 32, 246-252.

Campbell, B. A. (1981). Race-of-interviewer effects among southern adolescents. Public Opinion Quarterly, 45, 231-244.

Cantril, H. (1944). Gauging public opinion. New Jersey: Princeton University.

Carroll, J. D., and Arabie, P. (1983). INDCLUS: An individual differences generalization of the ADCLUS model and the MAPCLUS algorithm. Psychometrika, 48, 157-169.

Cohen, J., and Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences. Hillsdale, NJ: Erlbaum.

Collins, A. M., and Loftus, E. F. (1975). A spreading-activation theory of semantic processing. Psychological Review, 82, 407-428.

Colombotos, J. (1965). The effects of personal vs. telephone interviews on socially acceptable responses. Public Opinion Quarterly, 29, 457-458.

Cotter, P.; Cohen, J.; and Coulter, P. B. (1982). Race of interviewer effects in telephone interviews. Public Opinion Quarterly, 46, 278-294.

Davis, C., and Cowles, M. (1989). Automated psychological testing: Method of administration, need for approval, and measures of anxiety. Educational and Psychological Measurement, 49, 311-320.

DeLamater, J., and MacCorquodale, P. (1975). The effects of interview schedule variations on reported sexual behavior. Sociological Methods and Research, 4, 215-236.

De Leeuw, E. D., and van der Zouwen, J. (1988). Data quality in telephone and face to face surveys: A comparative meta-analysis. In R. M. Groves, P. P. Biemer, L. E. Lyberg, J. T. Massey, W. L. Nicholls II, and J. Waksberg (Eds.), Telephone survey methodology (pp. 283-299). New York: John Wiley.

DeNisi, A. S., and Peters, L. H. (1996). Organization of information in memory and the performance appraisal process: Evidence from the field. Journal of Applied Psychology, 81, 717-737.

DePaulo, B. M.; Kashy, D. A.; Kirkendol, S. E.; Wyer, M. M.; and Epstein, J. A. (1996). Lying in everyday life. Journal of Personality and Social Psychology, 70, 979-995.

Dillman, D. A. (1978). Mail and telephone surveys: The total design method. New York: Wiley.

Esaiasson, P., and Granberg, D. (1993). Hidden negativism: Evaluation of Swedish parties and their leaders under different survey methods. International Journal of Public Opinion Research, 5, 265-277.

Evan, W. M., and Miller, J. R., III. (1969). Differential effects on response bias of computer vs. conventional administration of a social science questionnaire: An exploratory methodological experiment. Behavioral Science, 14, 216-227.

Evans, R. I.; Hansen, W. B.; and Mittlemark, M. B. (1977). Increasing the validity of self-reports of smoking behavior in children. Journal of Applied Psychology, 62, 521-523.

Finkel, S. E.; Guterbock, T. M.; and Borg, M. J. (1991). Race-of-interviewer effects in a pre-election poll: Virginia 1989. Public Opinion Quarterly, 55, 313-330.

Fischer, R. P. (1946). Signed versus unsigned personal questionnaires. Journal of Applied Psychology, 30, 220-225.

Fidler, D. S., and Kleinknecht, R. E. (1977). Randomized response versus direct questioning: Two data-collection methods for sensitive information. Psychological Bulletin, 84, 1045-1049.

Fowler, F. J., Jr.; Roman, A. M.; and Di, Z. X. (1998). Mode effects in a survey of Medicare prostate surgery patients. Public Opinion Quarterly, 62, 29-46.

Franklin, L. A. (1989). Randomized response sampling from dichotomous populations with continuous randomization. Survey Methodology, 15, 225-235.

Gano-Phillips, S., and Fincham, F. D. (1992). Assessing marriage via telephone interviews and written questionnaires: A methodological note. Journal of Marriage and the Family, 54, 630-635.

Goffman, E. (1959). The presentation of self in everyday life. Garden City, NY: Doubleday/Anchor Books.

Goodstadt, M. S., and Gruson, V. (1975). The randomized response technique: A test on drug use. Journal of the American Statistical Association, 70, 814-818.

Gordon, R. A. (1987). Social desirability bias: A demonstration and technique for its reduction. Teaching of Psychology, 14, 40-42.

Groves, R. M. (1979). Actors and questions in telephone and personal interview surveys. Public Opinion Quarterly, 43, 191-205.

Hall, M. F. (1995). Patient satisfaction or acquiescence? Comparing mail and telephone survey results. Journal of Health Care Marketing, 15, 54-61.

Herzog, A. R., and Rodgers, W. L. (1988). Interviewing older adults: Mode comparison using data from a face-to-face survey and a telephone resurvey. Public Opinion Quarterly, 52, 84-99.

Himmelfarb, S., and Lickteig, C. (1982). Social desirability and the randomized response technique. Journal of Personality and Social Psychology, 43, 710-717.

Hinrichs, J. R., and Gatewood, R. D. (1967). Differences in opinion-survey response patterns as a function of different methods of survey administration. Journal of Applied Psychology, 51, 497-502.

Hochstim, J. R. (1967). A critical comparison of three strategies of collecting data from households. Journal of the American Statistical Association, 62, 976-989.

Horvitz, D. G.; Greenberg, B. G.; and Abernathy, J. R. (1976). Randomized response: A data-gathering device for sensitive questions. International Statistical Review, 44, 818-196.

Hough, K. S., and Allen, B. P. (1975). Is the “women’s movement” erasing the mark of oppression from the female psyche? Journal of Personality, 89¸249-258.

Hutchison, J.; Tollefson, N.; and Wigington, H. (1987). Response bias in college freshmen’s responses to mail surveys. Research in Higher Education, 26, 99-106.

Jobe, J. B.; Pratt, W. F.; Tourganeau, R.; Baldwin, A. K.; and Rasinski, K. A. (1997). Effects of interview mode on sensitive questions in a fertility survey. In L. E. Lyberg, P. P. Biemer, M. Collins, E. D. de Leeuw, C. Dippo, N. Schwarz, and D. Trewin (Eds.), Survey measurement and process quality (pp. 311-329). New York: John Wiley & Sons.

Jordan, L. A.; Marcus, A. C.; and Reeder, L. G. (1980). Response styles in telephone and household interviewing: A field experiment. Public Opinion Quarterly, 44, 210-222.

Kiesler, S., and Sproull, L. S. (1986). Response effects in the electronic survey. Public Opinion Quarterly, 50, 402-411.

Koson, D.; Kitchen, C.; Kochen, M.; and Stodolosky, D. (1970). Psychological testing by computer: Effect on response bias. Educational and Psychological Measurement, 30, 803-810.

Krosnick, J. A. (1991). Response strategies for coping with the cognitive demands of attitude measures in surveys. Applied Cognitive Psychology, 5, 213-236.

Krosnick, J. A., and Fabrigar, L. R. (forthcoming). Designing good questionnaires: Insights from psychology. New York: Oxford University Press.

Krosnick, J. A., and Green, M. C. (1998). The impact of interview mode on data quality in the National Election Studies. Unpublished memo to the Board of Overseers of the National Election Studies. Columbus, OH: The Ohio State University.

Krysan, M.; Schuman, H.; Scott, L. J.; and Beatty, P. (1994). Response rates and response content in mail versus face-to-face surveys. Public Opinion Quarterly, 58, 381-399.

Lautenschlager, G. J., and Flaherty, V. L. (1990). Computer administration of questions: More desirable or more social desirability? Journal of Applied Psychology, 75, 310-314.

Levin, J., and Montag, I. (1987). The effect of testing instructions for handling social desirability on the Eysenck personality questionnaire. Personality and Individual Differences, 8, 163-167.

Locander, W.; Sudman, S.; and Bradburn, N. (1976). An investigation of interview method, threat and response distortion. Journal of the American Statistical Association, 71, 269-275.

Martin, C. L., and Nagao, D. H. (1989). Some effects of computerized interviewing on job applicant responses. Journal of Applied Psychology, 74, 72-80.

McGeoch, J. A. (1942). The psychology of human learning. New York: Longmans, Green.

Mensink, G. J. M., and Raaijmakers, J. G. W. (1988). A model of interference and forgetting. Psychological Review, 95, 434-455.

Murray, D. M.; O'Connell, C. M.; Schmid, L. A.; and Perry, C. L. (1987). Addictive Behaviors, 12, 7-15.

Newton, R. R.; Prensky, D.; and Schuessler, K. (1982). Form effect in the measurement of feeling states. Social Science Research, 11, 301-317.

Nicholls, W. L., II; Baker, R. P.; and Martin, J. (1997). The effect of new data collection technologies on survey data quality. In L. E. Lyberg, P. P. Biemer, M. Collins, E. D. de Leeuw, C. Dippo, N. Schwarz, and D. Trewin (Eds.), Survey measurement and process quality (pp. 221-248). New York: John Wiley & Sons.

O'Reilly, J. M.; Hubbard, M. L.; Lessler, J. T.; Biemer, P. P.; and Turner, C. F. (1994). Audio and video computer assisted self interviewing: Preliminary test of new technologies for data collection. Journal of Official Statistics, 10, 197-214.

Ostrom, T. M.; Carpenter, S. L.; Sedikides, C.; and Li, F. (1993). Differential processing of in-group and out-group information. Journal of Personality and Social Psychology, 64, 21-34.

Paulhus, D. L. (1984). Two-component models of socially desirable responding. Journal of Personality and Social Psychology, 46, 598-609.

Pavlos, A. J. (1972). Racial attitude and stereotype change with bogus pipeline paradigm. Proceedings of the 80th Annual Convention of the American Psychological Association, 7, 292.

Pavlos, A. J. (1973). Acute self-esteem effects on racial attitudes measures by rating scale and bogus pipeline. Proceedings of the 81st Annual Convention of the American Psychological Association, 8, 165-166.

Potosky, D., and Bobko, P. (1997). Computer versus paper-and-pencil administration mode and response distortion in non-cognitive selection tests. Journal of Applied Psychology, 82, 293-299.

Pryor, J. B., and Ostrom, T. M. (1981). The cognitive organization of social information: A converging-operations approach. Journal of Personality and Social Psychology, 41, 628-641.

Quigley-Fernandez, B., and Tedeschi, J. T. (1978). The bogus pipeline as lie detector: Two validity studies. Journal of Personality and Social Psychology, 36, 247-256.

Raaijmakers, J. G. W., and Shiffrin, R. M. (1981). Search of associative memory. Psychological Review, 88, 93-134.

Reiser, B. J.; Black, J. B.; and Abelson, R. P. (1985). Knowledge structures in the organization and retrieval of autobiographical memories. Cognitive Psychology, 17, 89-137.

Roenker, D. L., Thompson, C. P., and Brown, S. C. (1971). Comparison of measures for the estimation of clustering in free recall. Psychological Bulletin, 76, 45-48.

Roese, N. J., and Jamieson, D. W. (1993). Twenty years of bogus pipeline research: A critical review and meta-analysis. Psychological Bulletin, 114, 363-375.

Rogers, T. F. (1976). Interviews by telephone and in person: Quality of responses and field performance. Public Opinion Quarterly, 40, 51-65.

Rosenstone, S. J.; Petrella, M.; and Kinder, D. R. (1993, June 21). Excessive reliance on telephone interviews and short-form questionnaires in the 1992 national election study: Assessing the consequences for data quality (NES Technical Report No. 43).

Rundus, D. (1973). Negative effects of using list items as recall cues. Journal of Verbal Learning and Verbal Behavior, 12, 43-50.

Schlenker, B. R., and Weigold, M. F. (1989). Goals and the self-identification process: Constructing desired identities. In L. A. Pervin (Ed.), Goal concepts in personality and social psychology (pp. 243-290). Hillsdale, NJ: Erlbaum.

Schober, M. F., and Conrad, F. G. (1997). Does conversational interviewing reduce survey measurement error? Public Opinion Quarterly, 61, 576-602.

Schuman, H., and Converse, J. M. (1971). The effect of black and white interviewers on black responses. Public Opinion Quarterly, 35, 44-68.

Sedikides, C., and Ostrom, T. M. (1988). Are person categories used when organizing information about unfamiliar sets of persons? Social Cognition, 6, 252-267.

Shimizu, I. M., and Bonham, G. S. (1978). Randomized response technique in a national survey. Journal of the American Statistical Association, 73, 35-39.

Siemiatycki, J. (1979). A comparison of mail, telephone, and home interview strategies for household health surveys. American Journal of Public Health, 69, 238-245.

Slamecka, N. J. (1968). An examination of trace storage in free recall. Journal of Experimental Psychology, 76, 504-513.

SPSS for Windows 8.0.0 [Computer software]. (1997). Chicago: SPSS, Inc.

Srull, T. K. (1983). Organizational and retrieval processes in person memory. Journal of Personality and Social Psychology, 44, 1157-1170.

StatSoft, Inc. (1997). STATISTICA for Windows [Computer program]. Tulsa, OK: StatSoft, Inc.

Sudman, S.; Bradburn, N. M.; and Schwarz, N. (1996). Thinking about answers: The application of cognitive processes to survey methodology. San Francisco: Jossey-Bass.

Tourangau, R.; Smith, T. W.; and Rasinski, K. A. (1997). Motivation to report sensitive behaviors on surveys: Evidence from a bogus pipeline experiment. Journal of Applied Social Psychology, 20, 209-222.

Tracy, P. E., and Fox, J. A. (1981). The validity of randomized response for sensitive measurements. American Sociological Review, 46, 187-200.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving, and W. Donaldson (Eds.), Organization of memory (pp. 381-403). New York: Academic Press.

Tversky, A., and Hutchinson, J. W. (1986). Nearest neighbor analysis of psychological spaces. Psychological Review, 93, 3-22.

Walker, A. H., and Restuccia, J. D. (1984). Obtaining information on patient satisfaction with hospital care: Mail versus telephone. Health Studies Research, 19, 291-306.

Walker, M. E. (1998) Standal: A program to format proximities and cluster memberships for performing stand-alone regression (Version 2.0) [Computer program]. Columbus, OH: The Ohio State University.

Warner, S. L. (1965). Randomized response: A survey technique for eliminating evasive answer bias. Journal of the American Statistical Association, 60, 63-69.

Weisberg, H. F.; Krosnick, J. A.; and Bowen, B. D. (1996). An introduction to survey research, polling, and data analysis. Thousand Oaks, CA: Sage.

Wiseman, F. (1972). Methodological bias in public opinion surveys. Public Opinion Quarterly, 36, 105-108.

Zdep, S. M., and Rhodes, I. N. (1976). Making the randomized response technique work. Public Opinion Quarterly, 40, 531-537.

Zdep, S. M.; Rhodes, I. N.; Schwarz, R. M.; and Kilkenny, M. J. (1979). The validity of randomized response technique. *Public Opinion Quarterly, 43*, 544-549.

Appendix 4: Memory Organization

Prior to the field trial, the NAOMS team conducted a literature review to determine whether a better understanding of memory organization would lead to insights on pilot recall period and the optimal questionnaire structure. After the review, the team prepared the test provided in this appendix.

Source: Concept paper generated by Dr. Jon Krosnick and Mr. Michael Silver, August 2, 1998.

Appendix 4: Memory Organization

Assessing How Safety-Related Events are Organized in Memory

Introduction

The wording of questions can be done in a variety of ways, given a list of possible safety events that we want respondents to recall. It is possible to employ simple, open-ended questions that do not rely on any type of recall organization (e.g., "Please tell me about all safety-related incidents that you have experienced during the last month."). However, questions that use cues to aid recall lead to more accurate and complete recollection (Tulving, 1972). The best method of cueing is to tailor questions to the mental organization used by the respondents, rather than using questions that impose an unnatural organization chosen by the researcher (Barsalou, 1988; DeNisi and Peters, 1996; Sudman, Bradburn, and Schwarz, 1996; Tulving, 1972). Perhaps surprisingly, memory often is not organized chronologically, with one discrete event following another in the order in which they occurred (Sudman, Bradburn, and Schwarz, 1996). Rather, people employ many different types of organization of events in memory (e.g., by activities, people) (Sedikides and Ostrom, 1988; Srull, 1983).

Identifying each respondent's memory organization scheme before each interview is not practical. However, it is possible to assess the most common type or types of mental organization used by our respondents and tailor our questionnaire design to those types. For example, if we were to find that most pilots store safety-related events (e.g., altitude deviations, unintelligible commands from ATC personnel) within activities (e.g., take-off, taxiing, landing), we could construct questions to match that organizational scheme. For example, we could instruct respondents to first think about any safety-related incidents that occurred during takeoffs during the past week and prompt them with a list of possible incidents. Alternatively, if pilots organize their memories according to the focus of attention when the problem occurred, we might first ask them to think about any problems they may have had with ATC personnel during the past month, and prompt them with a list of such possible incidents.

A search for the most common organization of information may lead us to the conclusion that pilots employ many different organizations, so no single approach will work best for a majority of respondents. If that occurs, our pre-testing would not point us toward an ideal scheme for questionnaire construction. However, if we do find a general organizational scheme, a structured questionnaire tailored accordingly is likely to be more effective at eliciting accurate and complete recall (Sudman, Bradburn, and Schwarz, 1996).

Techniques for Discerning Memory Organization

Several methods can be used to assess how events or other information are organized in people's memories:

- Open-ended verbal protocols (also called think-alouds)
- Listing
- Sorting
- Speeded recall.

This listing progresses roughly from the most exploratory technique to the most confirmatory one. For example, since verbal protocols rely on open-ended responses, they are best used to assess the structure of memory in domains where it is unclear in advance what structures may be prevalent, as is true for our situation. Having discerned likely structures, the latter techniques can be used on the list to confirm the existence of those structures.

Verbal Protocols. In a typical verbal protocol procedure, the respondent is asked to provide detailed answers to open-ended questions (e.g., "Please tell me about all the hassles you had at work last week."). As little prompting as possible is used to avoid imposing a structure on the recall that would not come forth spontaneously. Responses are recorded and later transcribed and coded for content that the researchers believe may describe the organization of the events mentioned (e.g., "time," "activities," "people") (Barsalou, 1988).

The key to analyzing verbal protocols is to examine the order in which the respondent lists events (Bickart and Fletcher, 1996). Events listed sequentially are most likely to be stored near each other in memory. Therefore, if a person lists all the hassles he had at work with Bobby first, and then lists all the hassles he had with Jeanette, this would suggest that the memories are organized by people. However, if the person lists a series of hassles with reaching people, followed by a series of hassles with orders being placed incorrectly, this would suggest a different organizational scheme. Such information can be used to structure future interviews according to the predominant organization observed. This exploratory method is being used more and more frequently in questionnaire and survey design (Sudman, Bradburn, and Schwarz, 1996).

Barsalou (1988) conducted one study employing this method. In this study, respondents were asked to describe events from their summer vacations in five minutes in whatever order the thoughts came to mind. These statements were recorded and transcribed. The transcripts were reviewed for indicators of any of several types of organization, including kinds of activities (e.g., swimming), specific events (e.g., going to a circus), extended events (e.g., traveling around Europe), and chronologically organized events (e.g., after school got out). Coders read the transcripts and recorded each type of organization indicator. Analyses of the frequencies of the indicators led the researchers to conclude that organization in this domain was hierarchical. Since all the specific events comprising an extended event were listed before the individual moved on to discussing another extended event, and the extended events were described chronologically, the organization scheme had three levels: (1) chronology, (2) extended events, and (3) specific events comprising each extended event.

For the current project, verbal protocols could be used to identify memory organization for safety-related events. Some pilots could be asked to describe their aircraft-related experiences during the past month. Other pilots could be asked to describe all the safety-related events they have experienced in the past. The transcripts from their recorded descriptions then could be analyzed for indicators of the several types of possible organizations anticipated to be relevant: chronology, phases of activity (taxiing, take-off, cruising, landing), people (co-pilots, ATC personnel, maintenance crews, schedulers, luggage handlers, flight attendants), or objects (parts of airplanes one is flying, other planes, trucks).

Tables 1 and 2 provide excerpts from two hypothetical transcripts. Table 1 presents a chronologically organized narrative, while Table 2 presents a location-organized narrative.

Table 1. Chronologically Organized Narrative.

Interviewer:	Please tell me about your safety-related work experiences during the last month.
Respondent:	Well, . . . on the 10th, just after take-off from LAX, we experienced a lot of what seemed to be wake turbulence. It was pretty hairy for a few seconds. . . . Then on the 21st, when I was flying to Dallas, there was that rowdy passenger. He was angry about something, I forget what, but he was making so much trouble for the attendants and the other passengers that we almost had to return. Somehow they got him to calm down though. . . . And on the 28th, I ran into wake turbulence again.

Table 2. Location-Organized Narrative.

Interviewer:	Please tell me about your safety-related work experiences during the last month.
Respondent:	Well, . . . I remember having a couple of altitude deviations. One was 1,000 feet, not too bad, but the other was 2,500 feet – pretty surprising when I realized what was going on . . . And, oh yeah, we had **two** experiences with rowdy passengers. One of them made a lot of commotion on the way from L.A. to New York, and the flight attendants were pretty upset about the whole thing And then the same thing happened again – a guy who was drinking too much, on a flight from New York to London.

Listing. Once we discern an organizational scheme or schemes from open-ended protocols, we should probably confirm the validity of our suspicions using a more confirmatory method. One such method – listing – is similar to the verbal protocol method but is more constrained. In one use of this method, respondents are presented with a series of sentences containing information about multiple people, each having multiple characteristics or traits in a random order, different for each respondent (e.g., John locked his keys in the car this morning, Mary ate roast beef for dinner Tuesday). After some period of time and an intervening task, the respondents are asked to list whatever they can recall about the sentences they heard, in the order that the ideas come to them. The advantage of a specific listing of discrete ideas is that the information is easier to analyze for organization than the completely open-ended responses of the verbal protocol.

The sequences of recalled information are coded according to the categories embedded in the sentences originally given to the respondents (e.g., time/day, person, activity). This sequential information is most often analyzed using well-developed statistical methods that indicate the degree of each type of organization, not as the open-ended responses from the verbal protocols are. These analyses may include multi-dimensional scaling, cluster analysis, or combinations of the two, depending on the nature of the data and the researchers' assumptions about the nature of the possible underlying organization (Tversky and Hutchinson, 1986).

A study by Ostrom, Carpenter, Sedikides, and Li (1993) used this method to explore whether information about people is organized by people categories (e.g., John, Mary) or by attributes (e.g., ambitious, likes golf). The researchers had theoretical reasons to believe that one or both of these two types of categories were used to organize information about people and designed an experiment to test this. The researchers presented respondents with four pieces of attribute information (specific information about a favorite TV show, favorite sport, college major, and a personality trait) about each of several different hypothetical people (e.g., Jack, Alan, Diane, and Betty). It was possible for respondents to organize the specific attribute information in their memories either by the person (e.g., Jack likes Hill Street Blues, boxing, is an engineering major, and is ambitious) or by attribute category (e.g., sports tastes: Jack likes boxing, Alan likes football, Diane likes figure skating, and Betty likes gymnastics).

Later, respondents listed the specific pieces of information in whatever order they came to mind. The order in which the attributes were recalled indicated how the information was organized. When a cluster of attributes that dealt with Jack followed another cluster of attributes that dealt with Alan, it could be inferred that memory for the attributes was organized by person, not attribute category. In fact, these researchers found that the type of organization depended on the gender of the respondent and the hypothetical person. Specifically, the respondents organized information about their own gender group (e.g., men reading about hypothetical men) according to person categories but organized information about the other gender group (e.g., men reading about hypothetical women) by attribute categories.

For our project, pilots could be presented with sentences or video clips about safety-related events, including information that allows for organization in any of the ways we are interested in testing. For example, we could include information about the day of the week (to look for organization by day), time of day, location, severity of the event, etc. Later, the pilots would be asked to recall all the information they could about the safety events. Analysis of the order in which that information is recalled would indicate how the information was organized.

Sorting. Another confirmatory method is sorting (Brewer and Lui, 1996). When using this method, a respondent is given a set of stimuli (e.g., pictures, cards with words on them) and is asked to organize them into as many stacks as needed based on their similarities. The organization imposed on the stimuli indicates how the stimuli would be represented in memory. These data also can be analyzed using the statistical methods described above for listing data, including analyses of hierarchical organization (Brewer, Dull, and Jobe, 1989). It also is possible to measure the amount of time it takes a person to sort a set of stimuli, and this can reveal the level of familiarity with the stimuli and/or the experience level of the sorter (Pryor and Ostrom, 1981). For example, it should be faster to sort information that matches one's experiences than information that does not.

Sorting can be either an exploratory or a confirmatory technique, depending on the nature of the stimuli. If stimuli are chosen randomly by researchers, assessments of similarities by respondents can identify common themes. If the researchers have a theory about the organization of information in that domain, then stimuli can be constructed with information relating to that hypothesized organization. The respondents' organization methods may then match the researchers' hypotheses to varying degrees.

An example of sorting is a study by Brewer, Dull, and Jobe (1984) exploring how people organize information about chronic health conditions; the study was conducted to improve a survey of chronic health problems. In that study, respondents were given 68 index cards; on each was typed the name of a different health condition. Respondents sorted the cards into as many piles as they felt were appropriate. The researchers created numerical matrices from these piles, indicating which illnesses tended to be grouped. A cluster analysis indicated that people tended to organize the illnesses into 12 separate categories based on body location and type of symptom, rather than strictly by the physiological systems used to organize the questions in the original survey. This suggested that a more effective organization for the updated questionnaire should match the one used by the respondents, not the one used by the experts who constructed the original survey.

For our project, pilots could be given index cards with safety-related events typed on them (embedding information about each of the ways we believed the information was most likely to be organized, such as time, people, location, etc.). For example, one card might refer to a 1,000-foot altitude deviation occurring 50 miles west of Chicago last Tuesday evening. Pilots would sort these cards in however many piles they felt were appropriate. The categories used by each individual could then be subjected to a cluster analysis to identify which categories tended to be used generally by the pilots. If, for example, the cards tended to be organized by severity of event (e.g., trivial, moderate, severe, near-fatal), that would be an indication that severity of event is a primary organizational strategy used by pilots.

Speeded Recall. One can measure how fast people perform a variety of recall tasks to reveal the memory organization used by respondents. Respondents are given a recall cue (e.g., "Please recall all your altitude deviations in the past year.") and are then asked to recall all relevant instances. According to Barsalou (1988, p. 217), "To the extent that subjects are faster at retrieving a certain kind of information, it is likely that the information is stored together in memory. Information that is not stored together, but is distributed throughout different sub-organizations, should generally take longer to retrieve…". Therefore, the amount of time taken to recall an event after receiving a recall cue and the amount of information recalled in a short time (e.g., 5 seconds) indicates the usefulness of that cue for recall (Barsalou, 1988; Reiser, Black, and Abelson, 1985). If cues are systematically varied among respondents (e.g., half the respondents receive a cue referring to the activity they were involved in at the time, while others receive a cue referring to whom they were with), differences in response times or amount of information recalled in a short time would indicate the relative use of each type of information as an organizer of information in memory.

Barsalou (1988) conducted one study using this method. Respondents were given recall cues relating to one of four categories (activities, participants, locations, times) and were given 60 seconds to report as many events as possible. The researchers were interested in which types of cues led to the highest quantity of recall within the first 5 seconds after the question was asked. There were no differences between the cue types, indicating that these memories were no more likely to be organized by one type than by another.

For our project, pilots could be given lists of safety-related events and later asked to recall as many as possible as fast as possible. During the recall phase, pilots would first be given cues from the categories thought to be most likely to organize those events. These may include time (e.g., "think of each day you flew"), location (e.g., "think of everywhere you flew"), or activity (e.g., "think of each phase of flight"). If more events are recalled within the first few seconds when cued by activity than by location or other cues, then it can be inferred that memory for such events is primarily organized by activity. In turn, this organizational information would allow the construction of more effective survey questions.

Each of these methods has advantages and disadvantages, and when used together, they permit convergence on the memory organization people employ. The most thorough way to assess how system operators organize memories for safety-related events would be to use a combination of all four methods, starting with the most exploratory method and continuing through the confirmatory methods. This would permit the highest degree of confidence in our conclusions about the organization of memories. However, resource limitations or other considerations may not permit all four methods to be used. In that case, some mix of methods could be constructed to complete the assessment as effectively as possible within the necessary limitations. The first method – verbal protocols – seems like a necessary first step in any such series of studies, because it is the only truly exploratory method and will provide an initial idea of how event memories are organized. Some combination of the other methods could then be used to test our ideas about how memories are organized.

Appendix 5: Satisficing and Social Desirability Bias

Prior to the field trial, the NAOMS team conducted a literature review to learn what worked with previous survey research efforts. The dearth of information concerning survey procedures and results for aviation-related personnel required the team to review the general literature associated with survey research methods.

In an attempt to select the most appropriate data collection mode, the team prepared this material about satisficing and social desirability bias, two important considerations for NAOMS that had not been widely recognized in the literature on modes.

Source: Concept paper developed by Dr. Jon Krosnick and Mr. Michael Silver, August 2, 1998.

Appendix 5: Satisficing and Social Desirability Bias

Literature and Past Research Review

When choosing among survey administration modes, a number of considerations are relevant (Weisberg, Krosnick, and Bowen, 1996, pp. 121-127). The first and most obvious is cost. Face-to-face interviews are usually the most expensive; telephone interviews are often significantly less expensive; and self-administered questionnaires are typically the least expensive. A second consideration is respondent satisfaction, which also favors face-to-face interviewing. In a study comparing respondents interviewed face to face and by telephone, Groves (1979) found that a large majority of the former respondents (78 percent) were satisfied with the experience, whereas only 38 percent of the latter respondents said they were satisfied. A third consideration is response rates, which again favors face-to-face interviewing. It is widely accepted that, at best, face-to-face surveys can achieve 70 percent response rates, telephone surveys can achieve 60 percent response rates, and mail surveys typically achieve 10 to 20 percent response rates unless heroic efforts are implemented (Dillman, 1978). Thus, in terms of the three criteria usually discussed in the survey methods literature, the more expensive a data collection method is, the better it performs.

Two other especially important considerations for an NAS survey have not been widely recognized in the literature. The first involves the notion of satisficing (short-cutting the thinking process involved in answering questions), which compromises data quality. Modes that encourage respondents to satisfice are therefore more problematic. The second is social desirability bias – the tendency to intentionally bias answers so as to present oneself in a more respectable way. Modes that encourage social desirability bias also compromise data quality.

Past studies linking modes to satisficing and social desirability bias have not yet been thoroughly reviewed in the literature. Therefore, it is important to conduct such reviews to maximize informed decision-making. The following discussion explains the notion of satisficing, links it conceptually to data collection modes, and reviews the findings of relevant past studies. Subsequent text reviews literature on social desirability bias.

Satisficing

The notion of survey satisficing is based on the assumption that survey researchers often ask respondents to do a great deal of cognitive work, for little or no real reward, to answer long sequences of difficult questions (Krosnick, 1991). Optimal response to questions involves executing four cognitive steps for each item a respondent confronts: (1) interpret the meaning of the question; (2) search memory for relevant information with which to construct an answer; (3) integrate the retrieved information into a single summary judgment; and (4) translate that judgment into a response. Clearly, the amount of effort required to answer even a short survey questionnaire is substantial.

Many respondents who initially agree to be interviewed are likely to exert the effort necessary to complete an interview optimally. However, many others who agree to be interviewed may become fatigued and lose their motivation to carry out the required cognitive steps as they progress through the questionnaire. Still other respondents who reluctantly agree to be interviewed, may do so with no intention of thinking carefully about the questions. The theory of survey satisficing specifies some of the likely attributes of these latter individuals. Specifically, the theory suggests that people who have relatively limited abilities to carry out the cognitive processes required for optimizing are the most likely to shortcut them. Also, people who have minimal motivation to carry out these processes are likely to shortcut the cognitive processes.

People can shortcut their cognitive processes in one of two ways: weak satisficing or strong satisficing. With weak satisficing, which amounts to a relatively minor cutback in effort, the respondent executes the same four cognitive steps involved in optimizing, but less completely and with more bias. One likely result of this is acquiescence: agreeing with any assertion offered by an agree/disagree question. People are likely to approach answering such a question with a confirmatory bias, which is exacerbated by reduced effort. This inclines people to agree with assertions.

When a respondent completely loses motivation, he/she is likely to offer responses that seem reasonable to the interviewer but require no memory search or retrieval. This is referred to as strong satisficing and can be done by looking for cues in questions that point to easy-to-defend answers. One obvious cue is a no-opinion option; it is easy and appealing for respondents to say they have no opinion on the issue so as to avoid thinking about it.

A second possible strategy of strong satisficing is non-differentiation. When respondents are asked to make a series of ratings on a single rating scale, respondents may select a point on the scale that seems generally reasonable and use that point over and over to rate a series of objects. For example, if a person is asked to rate the degree to which a series of personality traits describes a particular politician, it is relatively easy to select a point such as "somewhat well" (which would seem easier to defend than "extremely well" or "not at all") and rate each trait in this way.

If no cues in a question direct a respondent to a response option that seems especially reasonable, and easy to defend, people disposed to satisfice may resort to an especially extreme approach: mental coin-flipping. In such a case, a respondent simply chooses randomly from among the offered response alternatives. Thus, over multiple occasions, there would be no more than chance levels of consistency between answers to the same question from such a respondent.

A good deal of evidence supports the satisficing explanation for response effects (Krosnick and Fabrigar, forthcoming). For example, acquiescence is most common among people who have limited cognitive skills (as measured indirectly by educational attainment and more directly by intelligence tests), those that are less knowledgeable about the topic of the questions, and those that find thinking less enjoyable. Acquiescence is most common when questions are longer and harder to understand, when respondents are not instructed to answer carefully, when they have already answered a large number of previous questions, and when they believe they will not have to provide a rationale for their answers. When questions involve more complex language, and when questions appear later in a long questionnaire, no-opinion filters especially attract people who have limited cognitive skills and limited knowledge about the topic. Non-differentiation is most common among people who are low in cognitive skills, do not enjoy thinking, perceive a survey to be of limited value, have not been given instructions asking them to answer carefully, and have already answered a large number of questions. People who acquiesce also are especially likely to manifest non-differentiation, gravitate toward no-opinion responses, and, over time, demonstrate inconsistency. These response strategies all appear to be part of a syndrome emerging from common origins and consistent with the satisficing perspective.

In light of this theoretical perspective, interview mode might affect data quality. When an interviewer conducts a face-to-face conversation with a respondent, the interviewer's non-verbal engagement during the exchange is likely to be infectious. A respondent whose motivation is flagging or who at some point questions the value of a survey can observe that his/her interviewer is obviously enthusiastic about the data collection process. While some interviewers may not exhibit such commitment and enthusiasm non-verbally, many are likely to do so, thereby motivating their respondents in the cognitive processing required to generate thoughtful answers.

Respondents interviewed by telephone cannot observe their interviewers' non-verbal cues of commitment and enthusiasm. While telephone interviewers can convey commitment and enthusiasm verbally, these messages can be and probably are conveyed to respondents in face-to-face interviews. The lack of non-verbal messages during telephone interviews may leave those respondents less motivated.

A second key difference between modes is the pace at which the questions are asked. While all interviewers, no doubt, hope to complete each interview as quickly as possible, there may be special pressure to move quickly on the phone. Silences during telephone conversations can be construed as awkward, whereas a few seconds of silence during a face-to-face interview are not likely to be problematic (e.g., if the respondent can see that the interviewer is busy recording an answer). Furthermore, break-offs are more of a risk during telephone interviews, partly because talking on the telephone can be especially fatiguing for some people. As a result, interviewers may feel pressure to move a telephone interview along as fast as possible.

Even if interviewers speak more quickly on the telephone than they do face to face, respondents could, in principle, take the same amount of time to generate answers thoughtfully in the two modes. However, respondents might believe that interviewers communicate the desired pace of the conversation by how fast they speak and may be inclined to match these speeds. Consequently, people may spend less time formulating answers during telephone conversations. Also, respondents may find it difficult to understand rapidly asked questions and may misinterpret them. This can introduce error into the measurements.

Telephone interviewing may increase the likelihood of respondent satisficing and may therefore decrease the time and effort respondents devote to generating thoughtful answers. Consequently, data quality may decline. Some measurements may be improved by minimizing the effort people spend generating them, because rumination might cause people to mislead themselves about their own feelings, beliefs, attitudes, or behavior. Therefore, short-cutting cognitive processing might, in some cases, actually improve measurement reliability and validity. However, for most reports, more careful thought by the respondent is likely to yield more accurate data. In the most extreme case, respondents who strongly satisfice are not answering substantively at all. Thus, if telephone interviewing increases the amount of strong satisficing, data quality must, by definition, be decreased.

Some previous research offers evidence testing the hypotheses discussed above. Consistent with the satisficing hypotheses, two studies found more acquiescence in telephone interviews than in face-to-face interviews (Calsyn, Roades, and Calsyn, 1992; Jordan, Marcus, and Reeder, 1980). Four studies found that respondents said “don’t know” significantly more often in telephone interviews than in face-to-face interviews (Herzog and Rodgers, 1988; Jordan, Marcus, and Reeder, 1980; Krosnick and Green, 1998; Siemiatycki, 1979), although another study found no significant mode difference (Rogers, 1976). Krosnick and Green (1998) found more non-differentiation in telephone interviews than in face-to-face interviews. Thus, it appears that satisficing is more common in telephone interviews than in face-to-face interviews.

The theory of satisficing seems to predict that respondents would satisfice more in self-administered questionnaires than in face-to-face interviews, because accountability for answers is lower in the former case. However, the current literature does not validate that prediction. Hochstim (1967) found no difference between the modes in “don’t know” responses, and Krysan, Schuman, Scott, and Beatty (1994) found no difference between the modes with regard to the magnitude of effects of the order of response choices (another manifestation of satisficing) (Krosnick, 1991). Furthermore, Newton, Prensky, and Schuessler (1982) found more “don’t know” responses in face-to-face interviews than in self-administered questionnaires. Surprisingly, this suggests that self-administered questionnaires may be less susceptible to satisficing than face-to-face interviews.

The limited body of evidence comparing self-administered questionnaires to telephone interviews is mutually contradictory. Although Bishop, Hippler, Schwarz, and Strack (1988) found no differences in “don’t know” frequency between the modes, two other studies found more “don’t know” responses in self-administered questionnaires than in telephone interviews (Hochstim, 1967; Walker and Restuccia, 1984). This is consistent with the notion that self-administered questionnaires reduce accountability and, therefore, encourage satisficing. However, Bishop, et al. (1988) found more evidence of response order effects in telephone interviewing than in self-administered questionnaires. Again, there is no basis here for a strong conclusion that self-administered questionnaires are more problematic than telephone interviews with regard to satisficing.

Two studies can be used to compare the extent of satisficing in paper-and-pencil self-administered questionnaires and in computer-based self-administered questionnaires (Evan and Miller, 1969; Kiesler and Sproull, 1986). Neither of these studies found differences in the extent of acquiescence, so they suggest no difference between these modes in the extent of satisficing.

Thus, it appears that given a choice between face-to-face and telephone interviews, the clear choice from the satisficing viewpoint is the more expensive option – face-to-face interviewing – because it can assure higher exposure rates. However, the least expensive mode – self-administered questionnaires – is not clearly more susceptible to satisficing. Consequently, it may be the preferred mode, if we can implement procedures that assure sufficiently high response rates.

Social Desirability

The notion of "social desirability bias" is built on the premise that respondents sometimes intentionally lie to interviewers. DePaulo, Kashy, Kirkendol, Wyer, and Epstein (1996) had people complete daily diaries in which they recorded any lies that they told during a 7-day period. On average, people reported telling one lie per day, with some people telling many more, and indicated that 91 percent of the lies involved misrepresenting themselves in some way. This evidence aligns with theoretical accounts from sociology (Goffman, 1959) and psychology (Schlenker and Weingold, 1989), which assert that an inherent element of social interaction is constructing an image of oneself in the eyes of others in pursuit of relevant goals. The fact that being viewed favorably by others is more likely to bring rewards and minimize punishments may motivate people to construct favorable images, sometimes via deceit. If this sort of behavior is common in daily life, why wouldn't people lie when answering questionnaires as well?

In fact, there are a number of reasons to believe that the motivation to lie on surveys might be minimal. In most surveys, a respondent's relationship with an interviewer is likely to be so short-lived and superficial that very little of consequence is at stake. Certainly, even a small frown of disapproval from a total stranger can cause a bit of discomfort, but this is not likely to be especially noxious. Also, the cognitive task of figuring out which response to each question will avoid disdain from an interviewer might be demanding enough to be worthwhile only when the stakes are significant. However, people may become so accustomed to presenting themselves in favorable lights to others that they may naturally continue to do so during survey interviews, even if the real costs and benefits at stake are quite minimal.

Researchers have been very interested in exploring whether social desirability response bias is truly a source of data distortion, assessing its magnitude, and developing techniques to overcome it. The evidence documenting systematic and intentional misrepresentation is now quite voluminous and very convincing, partly because the same conclusion has been supported by studies using many different methods.

One such method is the “bogus pipeline technique,” which involves telling respondents that the researcher can otherwise determine the correct answer to a question they will be asked, so they might as well answer it accurately (Roese and Jamieson, 1993). Under these conditions, people are more willing to report substance use (Evans, Hansen, and Mittlemark, 1977). Likewise, Caucasian respondents are more willing to ascribe undesirable personality characteristics to African-Americans (Pavlos, 1972, 1973) and are more willing to report disliking African-Americans (Allen, 1975) under bogus pipeline conditions. Women are less likely to report supporting the women’s movement under bogus pipeline conditions than under normal reporting conditions (Hough and Allen, 1975). Also, people are more likely to admit having been given secret information under bogus pipeline conditions (Quigley-Fernandez and Tedeschi, 1978). Two meta-analyses of these types of studies have confirmed the overall increase in socially undesirable reporting under bogus pipeline conditions (Aguinis, Pierce, and Quigley, 1995; Roese and Jamieson, 1993).

Another approach to this problem involves the “randomized response technique” (RRT) (Warner, 1965), which has many variations. In one typical procedure, an interviewer presents a respondent with two questions: the sensitive question of interest and a non-sensitive question (for which the distribution of the characteristic in the population is known), both involving the same response choices (e.g., “yes” and “no”). Then the respondent, as directed by a randomizing method (such as the flip of a coin that the interviewer does not see), answers one or the other of the questions. The interviewer does not know which question the respondent has answered, but the distribution of responses to the sensitive question within the population can be estimated.

Horvitz, Greenberg, and Abernathy (1976) reviewed several validation studies of this technique, showing that the RRT results in more accurate reporting (as based on comparison with official records), as well as more disclosure of sensitive information than either non-anonymous or anonymous questionnaire conditions. Quite a few other such studies also have been conducted. Of these, 10 found less social desirability when using the RRT (Begin, Boivin, and Bellerose, 1979; Buchman and Tracy, 1982; Fidler and Kleinknecht, 1977;

Franklin, 1989; Goodstadt and Gruson, 1975; Locander, Sudman, and Bradburn, 1976; Shimizu and Bonham, 1978; Tracy and Fox, 1981; Zdep and Rhodes, 1976; Zdep, Rhodes, Schwarz, and Kilkenny, 1979). Only two studies found lower disclosure of sensitive information in the RRT condition (Brewer, 1981; Beldt, Daniel, and Garcha, 1982). For example, people answering via the RRT have admitted to falsifying their income tax reports and enjoying soft-core pornography more than did respondents who were asked these questions directly (Himmelfarb and Lickteig, 1982).

Still another approach to assessing the impact of social desirability is by studying interviewer effects. The presumption here is that the observable characteristics of an interviewer may suggest to a respondent which answers he or she would consider most respectable. If answers vary in a way that corresponds with interviewer characteristics, it suggests that respondents tailored their answers accordingly. For example, various studies have found that African-Americans report more favorable attitudes toward Caucasians when their interviewer is Caucasian than when the interviewer is African-American (Anderson, Silver, and Abramson, 1988; Campbell, 1981; Schuman and Converse, 1971). Likewise, Caucasian respondents express more favorable attitudes toward African-Americans and the principle of racial integration to African-American interviewers than to Caucasian interviewers (Campbell, 1981; Cotter, Cohen, and Coulter, 1982; Finkel, Guterbock, and Borg, 1991). These effects have occurred both in face-to-face interviews and in telephone interviews (Cotter et al., 1982; Finkel et al., 1991). In another study, people expressed more positive attitudes toward firefighters when they thought their interviewer was a firefighter than when they did not (Atkin and Chaffee, 1972/1973).

Anonymity of self-administered questionnaires reduces social pressure, so it offers another empirical handle for addressing this issue. In one study, Gordon (1987) used questionnaires to ask respondents about dental hygiene. Half the respondents (selected randomly) were asked to write their names on the questionnaires, and the other half were not. Dental checkups, brushing, and flossing were all reported to have been done more often when people wrote their names on the questionnaires than when they did not. Thus, socially desirable responses were apparently more common under conditions of high identifiability. Similarly, people report having more desirable personality characteristics when they are told to write their names, addresses, and telephone numbers on questionnaires than when they are not (Paulhus, 1984). Similar conclusions were reached in all other such studies (Becker, 1976;

Benson, 1941; Bishop and Fisher, 1995; Cantril, 1944; Fisher, 1946; Hinrichs and Gatewood, 1967).

Taken together, these studies suggest that some people sometimes distort survey answers in order to present themselves as having more socially desirable or respectable characteristics or behavioral histories. In this light, the notion that social desirability response bias might vary, depending on data collection mode, seems quite plausible. All of the above evidence suggests that people are more likely to be honest when there is a greater social distance between themselves and their interviewers. Social distance appears to be minimized when a respondent is being interviewed orally, face to face, in his/her own home. A relatively intimate rapport is probably established under those conditions, and a respondent might, therefore, feel he/she might observe frowns of disapproval or other non-verbal signs of disrespect from an interviewer. In contrast, a more remote telephone interviewer has less ability to convey favorable or unfavorable reactions to the respondent and may be interpreted as meriting less concern. Consequently, more social desirability bias might occur in face-to-face interviews than over the phone. Since self-administered questionnaires involve the greatest social distance of all, they might seem least susceptible to social desirability bias.

Surprisingly, the few studies done on mode differences do not support this hypothesis. Some studies have found no reliable differences between face-to-face and telephone interviews in reporting of socially desirable attitudes (Colombotos, 1965; Esaiasson and Granberg, 1993; Herzog and Rodgers, 1988; Rogers, 1976; Wiseman, 1972). Other work has found that reliable differences run opposite to the social distance hypothesis. For example, Aquilino and Lo Sciuto (1990), Aquilino (1994), and Krosnick and Green (1998) found more reporting of socially undesirable behaviors in face-to-face interviews than in telephone interviews. In fact, a meta-analysis of 25 studies concluded that face-to-face interviewing is less susceptible to social desirability bias than telephone interviewing (de Leeuw and van der Zouwen, 1988).

This may occur because the telephone does not permit respondents and interviewers to develop as comfortable a rapport as a face-to-face interview. Consequently, respondents may not feel they can trust their interviewers to protect their confidentiality. Consistent with this logic is evidence from respondent comments during surveys, revealing greater distrust of interviewers and discomfort about discussing sensitive topics over the phone (Aquilino, 1994; de Leeuw and van der Zouwen, 1988; Groves, 1979).

Consistent with the notion that social distance reduces social desirability bias, it appears self-administered questionnaires are less susceptible to this bias than face-to-face interviewing. Of seven studies on the topic, four found no difference in social desirability bias between the modes (Aquilino, 1994; DeLamater and MacCorquodale, 1975; Hochstim, 1967; Newton, Prensky, and Schuessler, 1982), but three studies found the self-administered mode to involve less social desirability bias than the face-to-face mode (Esaiasson and Granberg, 1993; Jobe, Pratt, Tourganeau, Baldwin, and Rasinski, 1997; Krysan, Schuman, Scott, and Beatty, 1994).

In light of these findings, it is not surprising that comparisons of self-administered questionnaires to telephone interviewing suggest that the former is less susceptible to social desirability bias. Of nine studies, three found no difference between the modes in social desirability bias (Hochstim, 1967; Hutchison, Tollefson, and Wigington, 1987), and six found the self-administered mode to yield less biased answers (Aquilino, 1994; Esaiasson and Granberg, 1993; Fowler, Roman, and Di, 1998; Gano-Phillips and Fincham, 1992; Hall, 1995; Walker and Restuccia, 1984).

Together, these studies suggest that self-administered questionnaires are least biased by social desirability, face-to-face interviews are somewhat more biased, and telephone interviews are most biased. Therefore, in this case, the least expensive technique yields the highest quality of data.

If we adopt the self-administered mode, it is worthwhile to consider whether to employ paper-and-pencil questionnaires or computer-administered questionnaires. A number of studies have explored the latter method. Computer methods consist mainly of either computer-assisted personal interviewing (CAPI), in which the interviewer types responses, and computer-assisted self interviewing (CASI), in which the respondent types his/her own responses. Some people have suspected that the computerized approaches, especially CASI, provide respondents with a greater sense of anonymity and may therefore increase their willingness to disclose sensitive information (Nicholls, Baker, and Martin, 1997).

Nine studies have compared the level of honest disclosure to sensitive questions between computer and paper-and-pencil self-administrations. Of these, two found no difference between the modes (Koson, Kitchen, Kochen, and Stodolosky, 1970; Potosky and Bobko, 1997). Two others found more social desirability bias in the computer mode (Davis and Cowles, 1989; Lautenschlager and Flaherty, 1990). Five studies found more honest disclosure on computers than on paper (Booth-Kewley, Edwards, and Rosenfeld, 1992; Evan and Miller, 1969; Kiesler and Sproull, 1986; Martin and Nagao, 1989; O'Reilly, Hubbard, Lessler, Biemer, and Turner, 1994). Therefore, for minimizing intentional distortion due to social desirability bias, computer administration of a questionnaire often can be superior to paper and pencil.

Integrating the Evidence on Satisficing and Social Desirability

Results of the literature review offered surprisingly harmonious implications regarding our upcoming choice of data collection mode. From the satisficing perspective, telephone interviews seem least desirable, and self-administered questionnaires seem as good or better than face-to-face interviewing. Likewise, self-administered questionnaires appear to minimize social desirability bias, while telephone interviews maximize this bias. One reasonable conclusion would seem to be that telephone interviews should not be used for our study, since they are not optimal according to either criterion, but there are other considerations that must be taken into account.

Self-administered questionnaires might appear to be favored, because they are less susceptible to social desirability bias than face-to-face interviewing and are significantly less expensive to conduct. However, this approach has a number of disadvantages, including significantly lower response rates (unless we can implement procedures to boost them) and an inability to implement complex skip patterns (unless the questionnaires are administered by computers, which entails some complexities of implementation if pilots are away from computers for extended periods). If these practical drawbacks can be overcome satisfactorily, the existing literature recommends self-administered over face-to-face data collection.

Solving the response rate problem is not likely to be simple. Through studies conducted in the 1960s and 1970s, Don Dillman (1978) developed the Total Design Method for maximizing self-administered questionnaire response rates; his book describes many studies that achieved very high response rates with it. Although much time has passed since then and all survey response rates have dropped during that period, the Total Design Method seems to be our only hope of achieving high response rates if we do self-administered mailed surveys.

The technique involves a number of complex guidelines regarding how the questionnaire should be printed, and these guidelines are likely to be easy to follow. The other key element of this method is mailing a series of packages to respondents at specified time intervals after the initial questionnaires are mailed out (specifically, mailings are done 1, 3, and 7 weeks after). In Dillman's studies, significant numbers of respondents were completing their questionnaires nearly 2 months after others. Thus, achieving a high response rate means that some of our respondents will most likely be completing questionnaires an unacceptably long time after the events to be tracked have occurred.

Our best hope may be to add elements to the Total Design Method that could increase how quickly questionnaires are returned. For example, incentives (e.g., money or gifts) could be mailed to respondents with the initial questionnaires. Also, letters could be sent to respondents in advance of the first questionnaire, indicating its arrival and explaining its significance. Such letters could be addressed by trusted and respected authorities (e.g., the Pilots Association), whose encouragement to complete the questionnaires promptly upon receipt might be effective.

Without significant steps along these lines, the self-administered questionnaire approach will have significant risk for low response rates. If that is acceptable for this project, we can move ahead with that mode, knowing that satisficing and social desirability considerations do not discourage such a course of action. However, if we need high-response rates to achieve public credibility for our results, and if we are unable to validate techniques for achieving such response rates quickly after questionnaires are mailed, we may have to adopt the face-to-face approach; if coupled with techniques to assure respondents of their anonymity, this may provide maximum data quality, but at a significant cost.

If cost is a compelling consideration, telephone interviews may offer the best compromise.

Appendix 6
Focus Group Questions

NAOMS staffers interviewed 37 active air carrier pilots (flying both domestic and international routes) during focus groups conducted in the Washington, D.C., area in August and September of 1998. These focus groups were designed to gather several types of information for use in creating an effective questionnaire. This section lists the interview questions asked in the focus groups.

Source: Battelle generated.

Appendix 6: Focus Group Questions

Open-Ended and Ranking Safety-Related Questions

In the open-ended questions, the NAOMS team used as little prodding or cueing as possible to avoid contaminating natural recall and description of events with our wording and organization. The team described the types of safety problems we were interested in by using wording similar to the following:

> "Our goal in this project is to create a questionnaire that will allow us to measure the number of safety-related problems in the aviation system each month. As you know, there are currently some systems keeping track of some of the problems that occur, but not all of them. We hope that, with your help, the questionnaire we design will allow us to monitor the frequency of problems in the whole system. We will be asking representative samples of U.S. pilots to complete our questionnaires each month to report on the recent incidents they are aware of.
>
> "The statistics summarizing answers to these questionnaires will be provided to government agencies, legislative committees, pilots unions and other unions, and industry officials to inform them of current levels and trends of safety problems. Therefore, it is important that the information we get through the survey be as complete and as accurate as possible.
>
> "Most of us on the research team are not professional pilots. In the questionnaire we will be writing, it's important that we be able to ask questions using wording that pilots like you use and would feel comfortable with. So the purpose of this group session is for us to learn about how you think and talk about issues related to safety. I will be asking you about safety problems so that we can learn to write effective questions for the questionnaire.
>
> "Before we get started, it's important that you know what we mean when we say we're interested in safety problems. We are interested in *all kinds* of safety problems – anything, no matter how big or small, and no matter what or who causes it, that *could* increase the chances of an accident happening. When you think about safety problems during the rest of this session, please think of both big and small problems that you think could lead to an accident. We want to know about all of them."

For the open-ended questions to be asked at the start of the group, we used wording similar to the following:

> "Is there a word or phrase that most pilots would understand to refer to what I've called safety problems?"
>
> "What types of events do you think of when you think of ___________?"
>
> (This blank was filled in with whatever term came out of the first question. Here we were especially interested in what basic jargon words they use besides "safety event" or even "safety").
>
> "What types of _____________ have you observed personally or heard about?"
>
> "How would you rank these safety problems, from the most serious to the least serious?"
>
> (Follow up with "Why?")
>
> "What types of safety problems have you experienced most often?"
>
> "Which types of safety problems have you *never* experienced?"

More Structured Safety-Related Questions

After the open-ended questions, we used sets of more structured questions using different types of cues to try to increase recall. We used wording such as the following to introduce this set of questions:

> "We need to have a complete list of possible safety problems, and there may be several types of potential safety problems that may not have come up yet but that you might feel are important if you were reminded of them. So now I'm going to mention a few things and see if they remind you of anything else you'd like to mention."

Phases of Flight

> "First, please think about preflight activities, fueling, and passenger and baggage loading. Do any of those remind you of other safety problems?"
>
> "How about during taxiing out and ATC clearance for takeoff?"
>
> "How about during takeoff and climbing?"
>
> "How about during leveling off and cruising?"
>
> "How about during ATC clearance for landing and during descent?"
>
> "How about during approach and landing?"
>
> "How about during taxiing in and parking?"

"How about during engine shutdown?"

"How about during passenger and baggage unloading and during post-flight activities?"

Equipment/Technology

"Now I'd like to mention different types of equipment you work with."

"How about problems with engines? Can you think of any types of safety problems that we haven't yet discussed?"

"How about problems with communications equipment, including voice communications, data links, GPS, and satellite communications?"

"How about problems with warning equipment, including equipment dealing with collision avoidance, fire, weather, and stalls?"

"How about problems with flight controls?"

"How about problems with analog and computer displays?"

"How about problems with auto-pilot and other automated systems?"

"How about problems with navigation equipment?"

"How about problems with radar?"

"How about problems with landing gear?"

People

"Now I'd like to mention the types of people you come in contact with."

"For example, what about flight crews?"

"How about attendants on your aircraft?"

"How about dispatchers?"

"How about air traffic controllers?"

"How about mechanics?"

"How about other ground personnel?"

"How about passengers?"

"How about the flight crews of other aircraft?"

"How about the experience levels of key personnel?"

Other Aircraft

"Now I'd like to talk about other aircraft."

"For example, what about near misses on the ground or in the air?"

"How about problems with wake turbulence?"

Weather

"Now I'd like to turn to weather conditions."

"What about problems from snow or icing?"

"How about rain?"

"How about hail?"

"How about lightning?"

"How about low visibility?"

"How about turbulence caused by weather?"

Locations

"Now I will mention some types of locations."

"What about problems flying into particular airfields or cities?"

"How about types or kinds of airfields?"

"How about particular regions of the U.S., like the Midwest, the South, etc.?"

"Has anyone flown international routes?"

(If "yes", follow-up with: Can you think of any problems with those?")

Time

"Now I'm going to mention times of day or year."

"What about any problems with night flights?"

"How about high traffic periods?"

Crew Scheduling and Training

"Now I'd like to ask about crew scheduling and training."

"For example, can you think of any problems dealing with fatigue?"

"How about problems dealing with the scheduling of inexperienced flight crew members?"

"How about problems dealing with scheduling people with personality or professional conflicts?"

"How about problems dealing with training before people enter the system?"

"How about problems dealing with on-the-job training?"

"How about problems dealing with simulator training?"

Regulations

"Next, I'd like to mention regulations."

"For example, can you think of problems with government regulations?"

"How about problems with company regulations?"

"How about problems with union regulations or procedures?"

"How about problems with incident reporting?"

"How about problems with procedures to encourage reporting of problems and suggestions?"

Self-Perceptions: What Pilots Can Remember

Here we asked pilots what kind of safety problems they think they can remember easily and what kind they think they would have difficulty remembering.

"Which of these types of safety problems do you think would be easy for you to remember?"

(Follow-up with "Why do you think so?")

"Which of these types of safety problems do you think would be hard for you to remember?"

(Follow-up with "Why do you think so?")

Reactions to Measurement Procedures

The following general set of issues addressed potential concerns of participants with the proposed survey procedures, content, or uses.

"Now we'd like to hear your opinions about how we might go about giving this questionnaire to pilots. First, though, I'd like to give you a bit more information about the ways we are thinking of asking pilots to answer safety-related questions so you can tell us what you think.

"As I mentioned earlier, reports from these questionnaires will be provided to officials to inform them of current levels and trends of safety problems. And it is very important that the information people report on the questionnaires be as complete and as accurate as possible.

"We will only be reporting summary statistics describing the questionnaire answers. That is, information about the frequency of safety problems would be reported, but no information about individual pilots would be reported.

"We will make sure that all answers will be completely confidential. We would need to keep track of who has responded to the questionnaire, but information identifying individual pilots would never be reported.

"Our budget would not allow us to pay pilots to complete the questionnaire, which will take about 20 to 30 minutes to complete.

"We are considering asking pilots to answer the questionnaire either only once or three times in one year.

"We are considering several ways to give the questionnaire. One way is to mail the questionnaire to pilots' homes and ask them to complete them and mail them back. Another way is to call pilots at home and ask questions over the phone. A final general way is to send interviewers to people's homes or to airports to conduct interviews in person.

"There are a couple of options for those general ways of giving out the questionnaire. For example, we could ask pilots to answer the questions using paper and pencil like most questionnaires, or we could ask pilots to enter responses into a computer. This could be done on their own computer at home or work using e-mail or a questionnaire on a Web page or even by sending a computer disk through the mail. Or pilots could complete the questionnaire on a notebook computer brought to them by an interviewer.

"Those are some of the things we're trying to decide when trying to create this questionnaire. Now I'd like to ask you some questions about your feelings about those ideas.

(1) "Do you have any concerns about anonymity, confidentiality, retribution, or any other negative consequences of admitting responsibility for or knowledge of safety-related problems?"

  (a) "What would make you feel more comfortable answering the questions?"

  (b) "Would anonymity assurances make you feel more comfortable? What kind?"

  (c) "What source or sources of such assurances would make you most comfortable? Your pilots' union? Another pilots' union? Several pilot unions together? Government (FAA, NASA, Attorney General)? An independent contractor? A university-affiliated survey organization?"

(2) "If you were answering the questionnaire, would you tell the truth and answer as carefully as possible?"

  (a) "Can you suggest what might motivate you to do so?"

  (b) "Can you suggest what might help you be better able to do so?"

(3) "Would other pilots probably tell the truth and answer as carefully as possible?"

  (a) "Can you suggest what might increase their motivation to do so?"

  (b) "Can you suggest what might increase their ability to do so?"

(4) "Would you feel comfortable about how the results of the questionnaire might be used by the government, the unions, companies, or the media?"

  (a) "What would make you feel more comfortable?"

  (b) "What information about the uses of the information would make you feel more comfortable?"

  (c) "Would anonymity or source credibility make you feel more comfortable?"

(5) "Do you think the questionnaire would take too much of your time or effort to fill out?"

  (a) "What would help that?"

  (b) "What would encourage you to be willing to spend more time and effort?"

(6) "Would you be willing to complete the questionnaire several times a year?"

  (a) "If not, why not?"

  (b) "If not, what would encourage you to complete one several times a year?"

(7) "Would you feel comfortable entering your questionnaire responses into a computer? A computer in your home? Over the Web? Over e-mail? Onto a disk to be mailed back?"

(8) "What would make you more comfortable about using a computer?"

(9) "Which way would you prefer? What would you feel most comfortable with?"

(10) "Do you think there is a need for the kind of information that this kind of questionnaire can provide?"

(11) "Would you want to get feedback on the questionnaire results? What feedback would you find interesting or useful? Why?"

Appendix 7: Event Lists Generated During Focus Groups and Interviews

The NAOMS staff gathered pilot input in August and September of 1998 by conducting focus groups and one-on-one interviews. During the three focus groups, pilots were asked to list all of the safety-related events that pilots experience. During the nine one-on-one interviews, pilots were asked to describe all the safety-related events they themselves had witnessed during their careers. Lists of all events mentioned by the pilots in these contexts are provided in this appendix.

The data analysis process began by circling each event mentioned in each transcript of the focus groups and individual interviews. Then, the events were typed into a single text file. In general, efforts were made to stay close to the language used by the pilots to describe the events.

Source: Safety-Related Events Mentioned by Pilots, prepared by Tina Rose (with Dr. Jon Krosnick and Mr. Michael Silver).

Appendix 7: Event Lists Generated During Focus Groups and Interviews

Equipment

Mechanical Problems in Flight

- Sometimes pilots have to reset circuit breakers.
- In Section A, regarding the potential inclusion of International Operations, item A3 should be redesigned to avoid errors. A distinction should be made between domestic and international flying, especially regarding Air Traffic Control (ATC) and language problems with international ATC.
- Mechanical problems.
- Problems with the intercom, headset, and radio cause delays and miscommunications with the intended parties.
- Problems arise because pilots receive faulty or incorrect electronic warnings.
- On one occasion, a light came on that indicated a hydraulic over-temp on one of the systems while the plane was taxiing. Instead of going back and discussing it with maintenance, the pilot turned the switch to that pump off and then turned it back on when the light was off. They continued with the flight as if nothing was wrong.
- Sometimes airplanes will rotate by themselves, and the pilot knows that the plane is out of line.
- This pilot has had problems with the compass not working properly during take-off.
- One time this pilot was having gear problems, and instead of landing and staying on the runway, the pilot chose to turn off the gear collapse on one side of the airplane.

Water Gets into FADEC

- On this pilot's plane, water was getting into the Full Authority Digital Engine Control (FADEC) through holes in the top of it, and engines were rolling back as a result of it. The pilot later clarified that the FADEC is a computer that receives all of the plane's data.

Computer Navigation System

- One time the computer navigation system died when the pilot was trying to land, and the pilot had to look out the window and figure out where the runway was.

Altitude Deviation Warning

- Sometimes there are problems with the altitude deviation warning not going off.

The MD-88

- You have to keep an eye on the flight management system on the MD-88.
- The MD-88 is known for having more altitude bugs than other airplanes.

Air-Conditioning Packs

- Sometimes they get air-conditioning packs that are out of service and the cockpit gets really hot. This adversely affects the pilots' performance because they are uncomfortable.
- When flying with a pack out, meaning that there is one air conditioner out, pilots aren't allowed to go above a certain altitude; otherwise, it is considered a safety issue.

Fuel

- There are times when pilots have to consume the airplane's reserved fuel due to weather or flight planning conditions.
- There are times when pilots will have to take the longer route in order to avoid weather because ATC won't let them take the shorter route. Many times, in situations like these, pilots begin to run low on fuel.
- Many companies have unrealistic fuel planning.
- Many times, pilots will have deviations which burn more fuel, and they are not informed as to why they have to deviate.
- In the last leg of a trip, many pilots like to go fast so they can get back and make their flights back home. Many times, they are running on minimum fuel.
- Companies tend to run the fuel close to the bone, which causes disagreements between the pilots and the dispatchers as to the amount of fuel on an airplane.

Altitude Select in ATR

- In the ATR, there is an altitude select that is not very user-friendly. This causes a problem because the pilot's attention gets focused on that instead of paying attention to other things.

Non-Standard Cockpits

- There are six models of DC-8s that come from eight different carriers, and each carrier has a different configuration of the cockpit, so when flying different airplanes, pilots basically have to figure out where everything is.

Engines

- One pilot lost an engine once at 6,500 feet and climbing on a hot summer day with full passengers. At best he was getting about 500 feet a minute rate of descent out of the airplane with full power up on the good engine. He declared an emergency and landed at an airport.
- One pilot has had to shut down two engines. Both incidents were caused by a loss of oil pressure.
- Sometimes, when an engine is started, loose tags off of bags can get ingested into the engine. A lot of metal gets ground up in the engine, and it goes out.

TCAS

- One pilot almost had a mid-air because the other plane wasn't required to have an emergency transponder. This pilot feels that all airplanes should be required to have a transponder.
- There are times when pilots almost have mid-airs because other airplanes don't show up on Traffic Collision Avoidance System (TCAS), and ATC doesn't warn the pilots about the other airplane.
- Turbojet cargo operators are not required to have TCAS onboard the aircraft.

Windshield

- Windshield glare interferes with a pilot's ability to see during critical phases of flight.
- Dirty windshields are also a problem.
- Sometimes the windshields shatter dramatically which can shake up certain pilots.

ATIS Low-Level Wind Shear System

- The ATIS low-level wind shear alert system always alerts pilots to the fact that there may be wind shears possible in a certain area, which is always a possibility, so pilots tend not to take it seriously.

Visual Approach Charts

- The charts that pilots receive from certain airports for visual approach are extremely inadequate because they are one color, so they don't show very much topography. Sometimes they don't show where cities are or where major land features such as rivers are.

Flight Charts

- At times, pilots don't receive charts of airfields. This is a problem, especially if the pilot needs to make an emergency landing.

Weather

Weather Delays

- Weather situations arise, many times, that cause pilots to have to change their destination, altitude, or route. Weather such as thunderstorms, icing, strong surface winds, and weather that wasn't forecast.
- There are some pilots who have to deviate on a daily basis due to weather.
- Many times pilots have to execute wind shear avoidance and recovery maneuvers.
- Wind shears on departure cause turbulence.
- Weather conditions at some airports become so severe with icy taxiways and extreme amounts of snow blowing that operations should not continue but they do anyway.
- In-flight icing is a problem.
- When the airplane has a lot of momentum going when landing, the differential thrust and braking action and the slick runway surfaces can retard the condition levers. This creates a momentary thrust which will pitch the airplane forward on the snow. If a ramper is not careful and you're not thinking about it, that airplane can move six inches and kill him.

Turbulence

- Wake turbulence causes a problem.
- Wake turbulence separation is a problem that this pilot worries about a lot.
- Turbulence is a safety problem for passengers and flight attendants.
- Sometimes turbulence is so bad that pilots are straining in their straps and they can barely read the gauges.
- Dispatch always wants pilots to fly through turbulence in order to get somewhere on time, and it's horrible. This increases the risk of having flight attendants get hurt.
- Flying in the winter is very difficult for a lot of pilots because, during many flights, it is dark when they leave and dark when they arrive. This situation

is really bad during turbulence because pilots don't know if their weather radar is on, and they don't know what's out there.

- There has been an increase in the amount of wake turbulence encounters due to the amount of global traffic that the U.S. is obtaining from other parts of the world.

Passengers

- Drunken passengers create the potential for problems.
- There are passenger problems. Problems with seating and carry-on bags were two examples mentioned.
- Flight crew members often have to help in handling a disruptive passenger.
- Drunken passengers cause problems.
- Irate passengers can cause stress among aircrew.
- Passengers who walk around while the seat belt light is on are a problem. If the airplane goes through some unforeseen turbulence, those passengers are going to get hurt.
- Disruptive passengers are a bigger problem than the public realizes.
- Passengers who disable the smoke detectors in the lavatories so that they can smoke are a big problem.
- Passengers sometimes put out cigarettes in the bathroom trashcan which is obviously a fire hazard.
- Disruptive passengers can downgrade safety.
- Sometimes passengers get the flight attendants so disheveled that they come up to the cockpit in tears.

Mid-Air Collisions

- Pilots have mid-airs or near mid-airs because of congestion or misunderstandings.
- If two airplanes go around on a land and hold-short situation where they are both unable to land, there is an 80 percent chance that they will have a mid-air.
- The pilots were caught unaware with a TCAS resolution decline for an aircraft that was just about to pass 500 feet directly below them. They looked at the TCAS screen before they began to climb and there also happened to be an airplane that was passing 500 feet above them.

- Congestion in the air causes a problem because there isn't sufficient maneuvering space, and when you ask air traffic control for another route, you usually get denied.
- Congestion coming into airports creates the potential for collisions.
- Sometimes airplanes come very close to one another because somewhere in the shuffle they lose their sequence.
- Many times, pilots will clear the visual approach, and then they will see another airplane in front of them. Situations like this can lead to less spacing between airplanes which poses a problem.
- Problems arise due to the amount of spacing behind an airplane.

Ground Operations

Vehicles/Equipment in the No-Infringement Zones

- Sometimes there are problems with equipment being in the clear ways.
- Sometimes vehicles on the ground are in the no-infringement zones, which increases the potential of the airplane hitting the vehicle or vice versa.
- The potential for ground collisions is a hazard.

Congestion on the Ramp/Taxiway

- There is a lot of movement on the ramp, and there are many airplanes in close proximity to one another, which is a potential cause for accidents.
- Taxiing in highly congested areas creates potential for an accident, especially when elements of weather are thrown into the mix.
- Problems arise due to congestion of airplanes and other vehicles on the ramp.
- There is a lot of activity going on around the airplane on the ground. This creates potential for an accident.
- There is a lot of congestion when taxiing.
- There are a number of incidents in which ground vehicles, baggage handlers, airline vans, and other types of traffic are crossing the taxiways. Airplanes have the right of way, but usually these vehicles cross and don't even look.
- Problems arise due to traffic on the runway, which results in the pilots having to do a go-around.

Cockpit Crew

Pilot Distraction

- Problems usually arise due to a chain of events. One thing happens that will draw the pilot's attention away from his job, and then another and another until an accident occurs. When changing airplanes, one crew will have to get the paperwork and another crew will do the pre-flight and they will set up the cockpit. Then, on occasion they will have a jumpseater, and then the crew will have to see if the jumpseater is qualified to fly with them. In addition to being pressed for time, all of these factors can lead to a safety issue.

Lack of Crew Members

- Sometimes there have to be cancellations because of a lack of crew members – generally, lack of flight attendants.
- Many times pilots fly with below the minimum number of crew.

Pilots Dial Wrong Radio

- At times, pilots will dial the wrong radio and begin to follow it.

Situational Awareness

- Situational awareness can be a problem because there are so many things going on around the pilot that he can get distracted.

Problems with Operating at the Right Altitude

- At some companies, the procedure is to operate in an altitude hold on the 747. By accident, a pilot operated on ALSEL instead of altitude hold, which caused the airplane to retract itself because the new altitude was not standardized.

People Bring Personal Problems into the Cockpit

- Sometimes individuals can't leave their problems outside the cockpit, which affects their performance.
- Some pilots' personal problems will affect their performance.

Familiarity Makes Pilots Dangerous

- The boredom and the familiarity with cockpits sometimes create a dangerous situation.

Poor Judgment by Pilot

- A pilot was flying into a level 5 or 6 thunderstorm, and he questioned the captain's decision to continue the approach. Eventually, the pilot convinced the captain to discontinue the approach because they were flying through heavy turbulence and heavy rain. Once they broke out, they were on a full scale deflection with such a heavy crosswind that they were very far off the localizer, and they came over the side of the runway rather than the end of the runway.

- The captain was circling a mountainous airport, and he decided that he could maintain his orientation while he circled. When he began his approach, he remembered that the flight had been delayed by two hours and that it was 1:00 a.m. at that airport. There were no cars on the freeway, and the freeway wasn't lit at all. He lost all of his bearings and wasn't sure where he was.
- Some pilots become so complacent with flying certain routes that they don't even pull out the charts anymore because they have the route memorized. This causes a problem because these pilots rely on the system in the United States so much that if they were to leave the United States they would be unable to operate.
- People who have worked with one company don't adjust well to the new policies at another company. The attitude is, "We didn't do it that way at my other company. It wasn't done. I don't know why we do it at this company."
- Some first officers roger ATC clearances and just assume that the captain heard them correctly.
- Not all crew members follow standardized procedures.
- Pilots have conversations in the cockpit during critical phases of flight.
- Pilots sometimes eat meals during critical phases of flight.
- Many pilots don't do what their job descriptions call for. They are not very responsible. Examples of this type of behavior were some pilots drink too much, and some pilots don't show up on time.
- Sometimes pilots don't remember or don't write down all of the information about a flight given to them by the company.
- Sometimes pilots take risks and land, even though their better judgment tells them that they should have gone around.
- Sometimes pilots misidentify traffic.
- Sometimes pilots misread charts.
- Sometimes pilots go onto incorrect taxiways.
- Occasionally, there are gross navigation errors.

Reckless Taxiing

- Sometimes people are taxiing very quickly and they almost have collisions with other airplanes that are taking off.

Pilot Proficiency

- The proficiency level of some pilots is not very good because pilots don't get enough flying hours.
- Proficiency levels vary because flying is based on seniority as opposed to skill level.
- Some pilots feel that they get too much time off between flights, which results in them making a mistake due to the recent lack of operating an airplane.
- In order to maintain currency, some pilots have to use the simulator. Some pilots even have to ask their company for a flight so that they can keep up.
- Education of the pilots has strayed away from teaching the nuts and bolts of flying to the point that if something really goes wrong, pilots may not have the background or understanding of all the systems on the airplane in order to get themselves out of trouble.
- The type of training that pilots receive now takes out the common sense factor because it becomes a cost factor thing.
- Many carriers are trying to hire people at lower rates due to cost-cutting measures. These people are not trained properly, which causes a problem.
- Some airlines hire people that are poorly trained for low pay, and a lot of these people don't speak the English language very well. This makes communication very difficult.
- In the past 10 years, the standard of training new pilots has been greatly lowered.
- Pilots learn escape maneuvers in terms of the Controlled Flight into Terrain (CFIT), which gives you the basic scenario where you've gone through the pitch up and full power firewall thrust to escape. At some airports, the training will throw other problems into the scenario, which is good training. However, most airports don't receive that kind of training.
- In some instances, pilots received a waiver for wind shear training when flying through the Rocky Mountains because it couldn't be simulated in the plane.
- There are certain training things that people won't even do, such as a V1 cut.

- At one pilot's company there weren't enough simulators, so some pilots couldn't even get time in the simulator.
- Due to the lack of training at one pilot's company, they refused to acknowledge that there was a possibility of prop over speed on the airplane that he was flying. However, it turns out that two airplanes actually went down due to that kind of problem.

Crew Members Don't Get Along

- Sometimes crew members don't work well together because their different personalities clash, which makes it difficult to concentrate on their jobs.
- Sometimes crew members don't get along very well, which distracts them.
- Personality conflicts between crew members leads to a lack of communication between them, which create the potential for safety problems.
- Many times, pilots will get frustrated with other crew members because they continually make the same mistakes.
- Sometimes crew members dislike each other, which causes frustration that eventually affects their performance.
- Sometimes a pilot's race, religious beliefs, and sexual orientation cause friction between the pilot and other crew members.

Pilot Fatigue

- Many times, pilots will have to fly over 8 hours a day, and they don't get enough time off to get adequate rest or do any of the other things they need to do before they fly again.
- Pilots have to fly at hours when they would normally be asleep, so many times they fall asleep while flying.
- Long work days.
- Pilots often fly fatigued.
- Pilots nod off during flights.
- Pilots don't receive enough time off in order to get adequate rest.
- Pilots don't receive enough time in hotels.
- During scheduled rest periods, pilots are often interrupted.
- Many times, pilots have to fly during periods that their bodies consider normal rest periods.
- Domestic flying is bad because pilots don't receive adequate rest periods.

- Many times, pilots have to use a seat in the flight deck as a rest seat and pilots can't rest in the flight deck. Sometimes pilots get a seat in first class designated for them, but that doesn't always happen. Pilots don't receive enough rest, and it is very hard on their bodies. The flight attendants need better accommodations as well.
- Pilots' lack of sleep adversely affects their performance.
- Sometimes pilots get tired and rely on the automation too much, and will make mistakes with regard to overrides in automation.
- On charter flights, pilots sometimes have to fly 12, 13, or even 14 hours without an augment. This particular pilot's record is 18 hours and 35 blocks with no augment, and that was when he had been up for 30 hours and in the seat for 23 hours. This practice is perfectly legal.
- Some companies will schedule a trip for 11.55 hours when they know it will really take 14 or more hours. Once you add weather delays or a ground stop to the total number of hours, the crew is exhausted by the time it's all over.
- If a flight is going to exceed 8 hours, there has to be an extra crew member. Some companies will list the flight as 7.59 hours so that they don't have to supply another crew member. Realistic scheduling is needed in order to have a safe operation, and many times, it's not done.
- There is a problem with their duty times. Due to the way the rules are written, airlines can literally take a pilot out on a trip and legally operate him while he sits in the plane for 7 days without ever going to a hotel.
- There are problems with regulation and length of duty day, which leads to pilot fatigue.
- The Federal Aviation Administration (FAA) says that pilots can fly up to 16 hours a day, even in bad weather conditions, with a sick airplane because they have a schedule to keep.
- Sometimes a pilot's personal judgment degrades the safety of a flight. For example, the pilot will decide to stay up and watch Monday night football even though he has a 5:00 a.m. call.
- Pilots don't receive proper accommodations for rest on domestic aircraft.
- Over-10 cockpit. This refers to spending over 10 hours in the cockpit, which is against regulation.
- Sometimes pilots are distracted due to lack of available food.

Air Traffic Control

Improper Use of Phraseology

- There needs to be a global standard for phraseology.
- Proper use of phraseology and non-standard phraseology results in miscommunication between the flight crew and air traffic control.
- The majority of pilots use incorrect terminology on their radios. Many pilots report that they are ready for take-off, which is not necessary. This adds to the number of radio calls being made. This creates a problem because then, the ATC has to come back and confirm.

Land and Hold-Short Clearances

- Pilots are often asked to accept land and hold-short clearance. Many times, pilots refuse land and hold-short clearances.
- Sometimes, pilots land on a runway where other pilots have been asked to land and hold short.
- At times, ATC gives pilots a land and hold-short when they weren't expecting to use the whole runway because of wind shear or because a 757 has landed in front of them.

"Slam Dunk" Approach

- Sometimes, when pilots are cleared for a visual, it turns out that it is difficult to land, because they were vectored to final very high and very fast. This was later clarified as a slam-dunk approach.
- Many times, pilots are given a visual approach that requires an excessive rate of descent. This is known as the "crowbar" or "slam-dunk" approach. This is a non-stabilized approach.
- Many times, pilots have to do a slam-dunk approach.
- ATC will lower their separation requirements in order to get planes in visual conditions. They do this because they are trying to handle too many planes, and they are trying to expedite things as much as possible. This was referred to by the pilot as a slam-dunk.

Problems with American ATC

- Air traffic controllers do not convey what they have in mind, which is sometimes different than what the pilot expects and plans for; therefore, when the pilots are told to do something other than what they expect, they are rushed to reconfigure the airplane.

- The air traffic controller will cue the mike and talk to three or four airplanes before letting up again, which makes it impossible for the pilots to acknowledge that they heard what was said until air traffic control lets up on the mike.
- Air traffic controllers sometimes put pilots in uncomfortable approach scenarios. They don't give adequate instructions as to what elevation the airplane should be at in order to make a visual approach.
- Air traffic controllers have the ability to see when an airplane gets off course; however, they don't give any kind of help whatsoever.
- There is miscommunication between the pilots and the air traffic controllers, meaning that the pilots think they hear one thing, but the air traffic controllers actually say another.
- One time, an air traffic controller was so busy that he gave the pilot a vector almost into the prohibited area over the Capitol. The pilots weren't able to get a word in because the controller was so busy. The controller continued to give the pilot bad instructions, and when the pilot complained and asked for a telephone number to talk to the controller, the controller was very upset with the pilot.
- Sometimes air traffic control doesn't call to the pilots' attention the proximity of other airplanes. Sometimes ATC alerts the pilots of other airplanes that don't affect them directly, and they don't alert them of other airplanes that are nearby.
- Sometimes, pilots are forced to drop into lower altitudes in order to accommodate ATC. When pilots complain about this, they are given an excuse instead of a solution to the problem.
- Some air traffic controllers don't give information to the pilots about turbulence unless they are probed for it.
- There are times when the controller will tell a pilot to do one thing, but the pilot misunderstands and does something else. Usually, in situations like this, the controller will roger whatever it is that the pilot is doing.
- A lot of times, controllers will talk entirely too fast when they are issuing instructions.
- Sometimes, controllers are not clear on what they want pilots to do.
- There is a lot of traffic in the air that controllers don't point out to pilots.
- Once, when flying, a pilot was about to approach the glide slope, and because of a mistake by the approach controller, there was another plane flying 500 feet below him on a glide slope right through the glide slope. The pilots checked the traffic resolution and fortunately didn't descend.

- Sometimes, pilots on a short final are asked by ATC if they can make the next taxiway when they are not even on the ground yet.
- Sometimes, controllers issue pilots a radio call that requires the pilot's response while they are on a landing roll-out or a short final.
- Sometimes, pilots will miss a clearance because of miscommunication between the pilot and ATC.
- On a push back, ATC wants you in a certain direction, and if they can't understand you, then either you're going to push back in the way of an oncoming airplane, or they'll push your tail in the wrong direction.
- On one occasion, an airplane in front of a pilot's airplane missed a turn and that plane and the tower control began discussing things back and forth. This pilot's airplane was coming up right behind the other and could not get a word into the controller because of their chattering with the other plane. This could have resulted in this pilot's plane having a wind shear problem because the controller was unavailable.
- Many times, during clearances for takeoff the ATC, will give the pilots a new altitude or a new heading which is different from the initial clearance.
- ATCs don't give accurate winds because the winds are really out of limits. This sometimes results in pilots having to fly through wind shears or a microburst.
- Sometimes, dispatchers don't follow the flights to the airport, and the airport is closed due to weather conditions.
- Failure to receive updated weather information from ATC is a big problem.
- There are times when pilots would like to deviate due to a weather situation, and they are told by ATC that they can't deviate, which is illegal.
- There are times when airplanes will be held in the air by ATC, even though there doesn't seem to be a reason for the holdup. ATC doesn't provide the proper information about when the plane will be allowed to make its approach, and many times, planes will be low on fuel.
- Sometimes the traffic that is pointed out to pilots is not necessary.
- Sometimes, at night, pilots accept visual approaches when they are behind other airplanes. ATC sometimes asks pilots to accept these types of approaches, and the pilots accept even though they would prefer not to.
- Sometimes on take-offs, pilots are asked to maintain visual separation on departure in order to facilitate capacity.

- The air traffic controllers are putting an extraordinary amount of information into the instructions for clearance. This makes it difficult for pilots to read back the clearance properly.
- Sometimes taxi clearances are so difficult to understand that the pilots need it read to them a second time.
- Sometimes approaches are interrupted because pilots might have to do S-turns, switch runways, or do some other non-standard interruption which can degrade safety.
- At some companies, a lot of flights will come in that have similar sounding numbers or the same numbers. Many times, by accident, pilots will pick up somebody else's number and start following their instructions.
- Sometimes pilots miss calls.

Blocked Transmission Due to Problems with Frequency

- Sometimes there are blocked transmissions, which means that two people are using the same radio frequency and one or both conversations can be heard.
- Blocked transmission.
- Usually, during thunderstorm activity, there is a lot of frequency congestion and air traffic control interplay, which is a problem.
- At times, pilots have to deviate due to weather, before or without a controller's authorization.
- Many times, there are blocked communications between pilots and ATC. Communicating is often impeded, confused, or disrupted.
- Sometimes pilots are unable to communicate with ATC in a timely manner.
- There are times when pilots are unable to get permission to turn off course because they can't get in on a frequency.
- One of the reasons pilots can't communicate with ATC is the land line.
- Another reason that pilots can't communicate with ATC effectively is due to the fact that they may be on the wrong frequency.
- Many times, there is a delay in communications. There is a large time span in between the pilot's request for information and a response from ATC.
- There are times when pilots have to make many attempts to contact the same controller.
- There are many times that pilots want to communicate with ATC, but they know that their message isn't going to be received.

- Frequency congestion on the ground causes a problem.
- A lot of pilots misuse the air-to-air frequency. One frequency is monitoring the emergency channel, and the other is monitoring the North-Atlantic Deltacom. Sometimes pilots use one like a party line to talk to each other.

Communication and Foreign Language

- Air traffic controllers in foreign countries don't speak English very well, so just getting clearance readbacks and ensuring that the pilots understood the controllers is difficult.
- Sometimes, air traffic controllers from foreign countries don't speak English at all.
- Air traffic controllers in foreign countries don't have a wide use of the English language, so when they're saying something, it means something different to them than it does to the pilots.
- Air traffic control in foreign countries does not always speak English very well, and pilots don't know if they are receiving accurate information.

Flight Attendants

- Sometimes flight attendants stay in the cockpit longer than they should.
- Angry flight attendants.
- Sometimes pilots have to fly with inexperienced flight crew members.
- Some fight attendants are over-authoritative, and when they break the chain of command, there is a breakdown in communication.
- Sometimes, flight attendants don't alert pilots about problems soon enough. Sometimes these problems get seriously out of hand.
- On one occasion, the catering service jammed a door closed without properly closing it and the door remained open at the bottom. The pilot realized that the door was open when a flight attendant noticed a loud sound coming from the back of the plane. There was another inexperienced flight attendant who was in the back and never mentioned the problem to the pilot. The pilot had to leave the panel so that he could try to fix the problem.
- There is a big problem with the cabin not being ready to land.

Ground Crews

- Ground personnel at commuter airlines are generally high school kids who have no training and are paid very little; therefore, they don't take their jobs very seriously.

- The ground crew will motion for the pilot to turn on the right and left engines without having a clear view of the sides of the plane; therefore, they (the ground crew) can't tell whether or not the propeller is clear.
- Sometimes, when the ground crew gives visual signals while not wearing their headsets, the signals are unclear because the lighted wands that they are required to use in the evenings are not working properly or they simply aren't using them.
- The training for the ground handlers is almost non-existent. For example, sometimes fuel trucks will be very close to an airplane that is taxiing in, and they don't know that they are required to do an emergency stop.
- One pilot has had three incidents of hitting a fuel truck because they can't see the wings. However, the person driving the fuel truck can.
- People who work on the ramp don't pay attention to what they are doing or to their surroundings. One time, a fuel truck was coming right at one of the planes, and the pilots tried to warn the truck by turning on all their lights, but the truck kept coming. Incidents like this have taught flight crews to be very aware because there is always the danger that someone is going to run into the plane.
- If a pilot is starting an engine and he or she can't communicate with the ground crew, then he or she will not get tuned in to the fact that the engine is going to light up improperly or catch on fire.
- At night, there is sometimes miscommunication between the pilots and the ground crew because the lighted wands aren't working, and pilots can't understand the hand signals.
- Sometimes there will be people on the ramp who will go in the back and push the luggage out and take the pogo out. The pilots are usually unaware that these people are there and the engines are usually running by then.
- Sometimes people get hit because there are so many different people rushing around the airplane.
- The non-standard use of pushback verbiage signals causes a problem. This refers to the signals that the ground crew uses to direct an airplane.
- Airlines tend not to spend a lot of money on the ramp equipment because the ramp people abuse the equipment, so companies don't want to pay to get things fixed.
- People rush around the aircraft on the ramp. The new employees are not supervised very well and generally do not have aviation backgrounds, so they're not aware of the dangers.

- A lot of the line personnel are not familiar with the proper hand signals. Pilots rely on these people to park the airplane because the pilots can't see the wings. One time the pilot was being directed to park and he almost hit another plane.

Baggage Handlers

- A baggage person pushing without clearing equipment is a problem.

Fuel Personnel

- Sometimes the person who refuels the plane doesn't put the cap back on or close the door.

Maintenance Workers

- One evening, a pilot needed to block out, and there was a maintenance problem on the airplane. The pilot called maintenance to get a referral number for the minimum equipment list (MEL), which is supposed to be an approved go. However, the maintenance controller refused to give him a deferral number. The controller said that once the cabin door is closed, maintenance won't come back on the airplane.
- At times, pilots will tell the maintenance people that they know something is wrong with the plane, but the maintenance people won't check the books to make sure, because they insist that they are right. So the plane will begin to taxi and something goes wrong. This delays the flight and when they go back to maintenance, the maintenance people will check the books and realize that they were wrong.
- Multiple MELs on the airplane cause a problem because sometimes they interrelate. If pilots don't read the fine print, and especially if there is contract maintenance, pilots don't realize it.

Gate Agents

- Sometimes the gate agent will shut the door while the plane is refueling which is not supposed to happen; however, they don't even check to make sure the door is open.

Dispatchers

- One pilot personally believes that dispatchers don't think in real time, because when they dispatch an airplane, they don't realize that there are 75 other airplanes trying to use the same taxiway and runway.

Pressure to Maintain a Schedule

- Problems arise because of gate agents wanting to push on time.
- Pilots are pressured or coerced into operating in a manner that they are uncomfortable with.
- Pilots are often asked to exceed their flight standards manual limits by keeping their air speed up to the marker.
- Sometimes, maintenance people pressure pilots to take airplanes that aren't fixed because there is a schedule to maintain.
- Many times, pilots are pressured by gate agents and other representatives to leave when they are not ready to leave.
- Many times, people other than the pilots put operational needs over aviation safety.
- At one pilot's particular company, you can deny a plane if certain items are present, such as a MEL on an APU. Well, instead of fixing the problem, they will send the APU down the line, because eventually someone will take it because they don't want to get a call from the chief pilot and they don't want to look stupid in front of other pilots.
- Sometimes, when pilots report things it causes a rather large delay. Then the pilot will probably get a call from the chief pilot or management representative wanting to know what happened and why the flight was delayed. This puts a lot of pressure on the pilot. Sometimes, because of the pressure, the pilot won't even report the safety issue.
- Pilots are pressured to get the airplane out on time even if it means disregarding safety issues.
- Sometimes, controllers try to force pilots to accept a visual.
- Sometimes, pilots are forced to accept an MEL the way it is in order to maintain schedule. If this happens, there may be altitude restrictions that may force a flight to fly in a weather system that would normally be below the flight path, such as thunderstorms, icing, and turbulence.
- Airplanes are pushed to keep a certain schedule, and because everyone is constantly being rushed to get things done, many problems can occur. For example, the injury of a crew member, which would result in the airplane having to divert to another airport, which causes another problem because there may be other airplanes close by. Many times, pilots will accept downgraded maintenance in order to keep their schedule.
- Sometimes, pilots are pressured to land in bad weather conditions instead of circumnavigating, because if one pilot can do it, so can another.

Maintenance Issues

- Maintenance items on the airplane are pencil-whipped, literally fixed before the engine stops turning because the plane has got to move. Sometimes they are not fixed at all.
- The air crew signs off maintenance problems that are no big deal, but eventually all of those little problems that don't get fixed become big problems when they are combined.
- Pilots have to request that a tire be changed because it is worn or a chunk is missing out of it.
- Sometimes pilots receive planes that have a discrepancy that the previous crew didn't write up.
- Sometimes items are written up as deferred, even though they are in working order.
- Companies or manufacturers give pilots bad information regarding the maintenance of the airplane. The manufacturer puts out advisory messages that indicate problems with the airplane. Pilots feel that these advisory messages indicate a far more serious problem that requires maintenance.
- Many times, pilots take airplanes that have one or several maintenance warnings.
- Pilots are sometimes sent on a flight with MELs that are conflicting.
- Sometimes, pilots have maintenance problems that the logbook shows has a history of not being able to duplicate the problem which they are experiencing.
- There are times when pilots know of a discrepancy, but they don't write it up.
- There are times when maintenance will be satisfied with the condition of an airplane; however, the pilots won't be, and they refuse to take the plane, which is against company policy.

Airport Issues

Problems during Pushback

- There are all sorts of interruptions during one of the most critical phases, which is the time before the pushback.

Standard Instrument Departures

- Standard instrument departures out of an airfield vary depending on what runway you take off from. If pilots are expecting to take off from one runway, and they end up having to take off from a different runway, it causes a problem.

Problems during Approach

- Sometimes, when a pilot is established on approach, there will be a TCAS alert.
- Pilots are sometimes asked to side-step to another runway or change their approach after they've had initial check.
- Many times, pilots are cleared for landing and approaching the landing flare while the departing airplane is still on the runway.

Airport Facility Design

- It appears that the facilities at the airport where this one pilot works are not adequate for the amount of traffic they receive.
- Sometimes taxiways are confusing.

Inadequate Airfield Markings

- At a lot of airports, the taxi lines and markings and runway markings are not very visible, especially at night.
- Air field markings are sometimes ambiguous.
- International airports don't have standardized markings, which causes confusion, especially if you've never been to that airport or haven't been there in awhile.
- The runway markings and taxi markings are a problem, especially at night, because they aren't very visible. When the pilot responds to air traffic control, it takes his attention away from looking at the lines, and then it is hard for him to regain sight of them.

Short Runways

- At some airports the runways are relatively short, and there are many airplanes in close proximity. This causes planes to have to do go-rounds.
- Some airports are more hazardous than others.

Hub-and-Spoke System

- The hub-and-spoke system causes taxiway gridlock.

Other Issues

Errors in Take-Off Data

- Errors sometimes occur because of changes in bag count. This causes the crew to have to recalculate their weight and balance performance information. When time constraints are thrown into the mix, it causes problems.
- Sometimes, there are errors in the delivery of the take-off data, which causes the pilot to have to call the company. Take-off data would include bag counts and passenger counts, for example.
- At times, pilots will discover FMS entry errors or database way point errors.

Flight Management System

- There are problems with the flight management system. Sometimes, the controller will call the route that the pilot is on something other than what it is called on the chart.
- There are times when pilots get so wrapped up in programming the FMS that nobody is flying the plane.

Security at Airports

- Airlines hire $4.50-per-hour high school dropouts, which gives them access to the entire airport. This causes a security issue, because there is the potential for sabotage.

Government

- The government gets plenty of information from the National Transportation Safety Board (NTSB) about problems, and they don't do anything about them.

National Transportation Safety Board

- One pilot has a problem with the NTSB. The pilot states that he or she thinks that there are things that they (NTSB) know about.

DOT On-Time Reporting

- Department of Transportation (DOT) on-time reporting has a negative influence on companies and operations.

Non-Standard FAA Procedures

- The FAA is not standardized across the country; therefore, certain inspectors will approve certain things, and others will approve others.

Airline Abuse of Crew

- Non-union airlines tend to abuse crews.

Communication between Pilots on Separate Airplanes

- In one situation, there were two planes that needed to land, but neither one of them would accept a visual approach. One pilot had to do a 360 on the final, because the other plane wouldn't accept a visual, and the other plane wouldn't communicate with the pilot.

Radar Coverage outside the United States

- In the U.S., pilots can fly anywhere and be guaranteed radar coverage at all altitudes, radio coverage, and weather radar coverage. Once they leave the U.S., they are basically on their own.

Center of Gravity

- The performance parameters and the certification of the aircraft depend on your CG being forward of a certain point. Sometimes, when you take off, you can tell that there's a little bit of this rear CG, which only causes a problem if you lose an engine.
- Inadvertent over-rotation due to poor weight and balance procedures is a problem.

Overweight Baggage

- Many airplanes are very tail-heavy due to overweight baggage.
- Overweight baggage causes a problem.
- Many planes have problems with being well overweight due to overweight baggage. There is no standard in the manual regarding how many times a bag should be weighed or if large bags should be treated as two bags, etc.
- During hunting season, people will pack coolers with dry ice, which adds a lot of weight to the plane.

Severe Weather Avoidance Program

- The Severe Weather Avoidance Program (SWAP) causes airlines to put a ground stop on a flight at the airport because there is weather an hour away that is heading their direction. In that one hour, the weather is usually right over the airport, and then the flight is allowed to take off. If the flight hadn't been delayed, then they probably could have avoided the weather.

Interruptions in the Cockpit

- At times, pilots are forced to leave the cockpit in order to make minor repairs.
- Non-emergency sterile cockpit interruptions are a problem.
- There are times when communications to ATC are disrupted because of cockpit interruptions. Pilots sometimes miss their call because they are talking about something else.
- Frequently, checklists are interrupted by a flight attendant or a gate agent who has to come to the pilot in order to resolve a discrepancy in the back.
- At times, the first officer has to get off the radio due to some distraction while the plane is still on the ground or while they are still on tower frequency. This is not an ideal situation, because the first officer is unable to receive the necessary instructions and information that he needs.

Birds/Animals in Path

- At times, pilots have to deviate from their flight path due to an imminent bird strike.
- Bird strikes are a problem.
- Sometimes there will be wild animals on the runway.
- There has been an increasing problem with wild animals being on the runway. There has also been an increase in the number of bird strikes.

Appendix 8: Workshop 1

NAOMS held Workshop 1 on the developing program on May 11, 1999, in Alexandria, Virginia. Its purpose was to acquaint stakeholders with the nature of the program and its methods, and to enlist their support in implementing the program. During the workshop, held May 11, 1999, in Alexandria, Virginia, the 76 participants formed breakout groups and provided the following comments, questions, and recommendations to the NAOMS team.

This appendix includes the workshop agenda and attendance list, as well as the feedback from workshop participants.

Source: Battelle generated from NAOMS Workshop 1 materials.

Workshop 1

Agenda and Participants

Workshop 1 Agenda

8:00 to 8:30 A.M.	Registration
8:30 to 9:00 A.M.	Linda Connell will provide project overview with focus on policy issues and the reason for the workshop.
900 to 9:40 A.M.	Bob Dodd will introduce the project goals and tasks completed to date. He also will focus on the tasks to be completed in FY99. This session will include a high-level discussion of the experiment; planned accomplishments; and the outcome, including analysis products.
9:40 to 10:00 A.M.	Break and Questions
10:00 to 10:45 A.M.	Jon Krosnick will speak about survey research methods and the development of the survey instrument. His primary goal is to describe the strengths and weaknesses of survey research methodology, using examples where possible. Jon will describe how we developed an instrument that was reliable and valid.
10:45 to 11:15 A.M.	Joan Cwi will discuss the process of applying the survey, emphasizing that the process will be anonymous and that we hope to work with the stakeholders to facilitate the process.
11:15 to 11:45	Linda Connell will speak again, setting up the workshop and speaking specifically to the sensitivity issues that she perceives might be a problem.
11:45 to 1:00 P.M.	Lunch
1:00 to 1:15 P.M.	Introduction to Workshop Activities
1:15 to 3:15 P.M.	Working Groups
3:15 to 3:30 P.M.	Break
3:30 to 5:00 P.M.	Work Group Summaries and Discussion

Workshop 1 Attendance List

FIRST NAME	LAST NAME	ORGANIZATION	OFFICE	JOB TITLE
Mark	Anderson	Virginia Polytechnic Institute and State University	Associate Professor	
Mac	Armstrong	United Airlines		
Henry	Armstrong	Federal Aviation Administration	Rotorcraft Directorate	Manager
Julie	Austin	United Airlines		
Susan	Baker	Johns Hopkins Injury Prevention Research Center		Professor
Jim	Blancahrd	Embry Riddle Aeronautical University		Professor
Phil	Boyer	Aircraft Owners and Pilots Association		President
Bill	Bozin	Air Transport Association		
Mads	Brandt	Teledyne Controls		Director, Flight Data Systems
Joseph	Breen	Transportation Research Board National Research Council		Senior Program Officer Aviation
Malcom	Brenner	National Transportation Safety Board		
Jan	Brett-Clark	Federal Aviation Administration		
R. Thomas	Buffenbarger	The International Association of Machinists & Aerospace Workers		President
Phillippe	Burcier	Airbuse Industries		Operational Prevention and Safety Assurance
Brigadier General Charles M.	Burke	U.S. Army Safety Center	U.S. Army Safety Center	
Kim	Cardosi	U.S. Department of Transportation		Engineering Psychologist
Rick	Cassell	Rannoch Corp.		
Terry	Clark	Alaska Airlines		
Walt	Coelman	Regional Airline Association		
Steve	Corrie	Federal Aviation Administration	Office of System Safety	
James	Deimler	Flight Data Company		Regional Manager
Thomas	Diefiore	Federal Aviation Administration	Aviation Safety Division	
Eleana	Edens			
William	Edmunds	Airline Pilots Association		
Carolyn	Edwards	Federal Aviation Administration	Office of System Safety	
Jack	Enders	Enders and Associates		President
Ray	Fenster	Association of Flight Attendants		
George	Finelli	National Aeronautics and Space Administration	Aviation Safety Program Office	Aviation Safety Program Office
Charles	Fluet	Federal Aviation Administration	Office of Integrated Safety Analysis	Deputy Director
Roy	Fox	Bell Helicopter		
Mike	Gallagher	Federal Aviation Administration	Transport Airplane Directorate	Manager

FIRST NAME	LAST NAME	ORGANIZATION	OFFICE	JOB TITLE
Daniel	Garland	Embry Riddle Aeronautical University	Department of Human Factors and Systems	Chair
Major General Francis C.	Gideon	Air Force Safety Center		
Curtis	Graeber	Boeing Commercial Airplane Group	Human Engineering	Chief
Christopher	Hart	Federal Aviation Administration, ASY-1		Assistant Administrator
Chuck	Hedges	Federal Aviation Administration	Office of System Safety	
Captain Mike	Holtom	Meridian	Senior Manager, Safety	
Charles	Huettner	National Aeronautics and Space Administration	Aviation Safety Research	Director
Mike	Kennedy	Pratt & Whitney		
Dr. James	Kuchar	Massachusetts Institute of Technology	Department of Aeronautics and Astronautics	
Carl	Kuwitzky	SouthWest Airlines Pilots' Association		Chairman, Air Safety Committee
Bruce	Landsberg			
John	Lauber	Airbus Industries		Airbus Training Center
Captain Richard	LaVoy	Allied Pilots Association		President
Nancy	Leveson	Massachusetts Institute of Technology	Hunsaker Visiting Professor of Aeronautical Information Engineering	
Guohua	Li	Johns Hopkins University Hospital		
Bernard	Loeb	National Transportation Safety Board		Director, Office of Research and Engineering
Thomas	Longridge	Federal Aviation Administration	Data Management and Analysis Section	Aviation Research Psychologist, Supervisor
Nancy	Mathiowetz	Joint Program in Survey Methodology		Assistant Professor
Stuart	Matthews	Flight Safety Foundation		President
John	McCarthy	Naval Research Laboratory		Manager, Scientific and Technical Program
Michael	McNally			
Tom	McSweeny	Federal Aviation Administration	Office of Regulation and Certification	Associate Administrator
John	O'Brien	Air Line Pilots Association		Director, Engineering and Air Safety
John	Olcott	National Business Aircraft Association		President

FIRST NAME	LAST NAME	ORGANIZATION	OFFICE	JOB TITLE
Jay	Pardee	Federal Aviation Administration	Engine & Propeller Directorate	Manager
Dave	Patterson	MacFadden and Associates		Senior Consultant
Ben	Phelps	National Air Traffic Controllers Association		Safety Coordinator
Tom	Poberezny	Experimental Aircraft Association		President
Jacques	Press	Federal Aviation Administration	FAA Technical Center	
Ronald	Robinson	Boeing Commercial Airplane Group		Director, Airplane Safety
Paul	Russell	Boeing Commercial Airplane Group	Airplane Safety Engineering	Chief Engineer,
Stewart	Schreckengast	The Mitre Corporation		Ph.D.
David	Schroeder	Federal Aviation Administration	Human Resources Research Division	Manager
Ronald	Simmons	Federal Aviation Administration	Human Factors Division AAR-100	
Catherine	Simonne-Jondot	Airbuse Industrie		Group Manager, In-Service Data Collection
Stan	Smith	National Transportation Safety Board	Data Systems	Manager
Captain Ed	Soliday	United Airlines	Safety & Security	Vice President
Jeremy	Sprung	Sandia National Laboratories		
Larry	Sukut	Alaska Airlines		
Ronald	Swanda	General Aviation Manufacturers Association		Vice President Operations
Dr. Jay	Swink			Senior Technical Specialist in Crew Systems Technology
Robert	Toenniessen	Federal Aviation Administration, ASY-100	NASDAC	Manager
Robert	Vandal	Flight Safety Foundation		Executive Vice President
Ron	Wojnar	Federal Aviation Administration	Transport Airplane Directorate	Manager ANM-100
Richard	Wright	Helicopter Association International		

Workshop 1

Feedback from Workshop Participants

Group A

Work Group Discussions

Question: Do we have the courage to act on the data we collect?

- Maybe
- Could be heroes or villains
- The data will not be ignored
- But, reasonable people may disagree about the actions it does (or does not) motivate

Question: Could we reform existing data sources instead?

- In some cases, yes
- But, many existing data collection efforts are passive, not active and statistically designed
- NAOMS should avoid redundancy unless that redundancy serves to validate

Other Comments

- Not linking causal factors to events is a mistake

  —Will lead to data that cannot be analyzed

- Need to explain why some questions relate to the past 30 days and others to the past year

  —Not obvious from survey design

  —Could be off-putting to respondents

- Need to recognize the limitations of the survey

  —Not create expectations that cannot be met

- Causal information may be at wrong level of detail

  —Is not sufficient to support intervention strategies

Group B

Work Group Discussions

Question: Do you have specific suggestions regarding the conduct of the field trial?

- Important to experiment with sampling during trial (i.e., medical-based)
- Obtain more feedback
- Additional survey needed to encourage questions/comments on the original survey

Question: Have we adequately addressed issues surrounding data sensitivity and use?

- There needs to be a statement in the first paragraph stating the confidentiality agreement
- Link it to ASRS, to show a pattern of confidentiality
- Get AOPA and ATA to endorse it early and clear on the front page
- Needs an endorsement letter to assure the aviation community of its support
- Overall consensus was that the issues have been addressed adequately

Question: Could you suggest ways of improving the proposed data collection process?

- Recommend surveying on a monthly basis; need to look at 30-day data to identify trends
- Is there a core questionnaire for all groups; or is this survey tailored to each group (i.e., flight attendants, pilots, etc.)?
- Send out quarterly reports
- Date the survey it so you can refer back to it in 30-day increments
- Why not 60-to 90-day increments?

Question: What can we do to maximize participation and response in the field trial and beyond?

- Needs to be clarified that this is not a duplication of information
- Need to give followup data to close the loop:

  —Post Card

  —Web site

  —Callback or Directline Publications
- Persons being surveyed need to see that this survey has had a direct impact on future survey tools

Question: Do you have suggestions for ways to improve the survey instrument?

Flight Experience Section

- Shorten form
- Use standard categories: light, medium, and heavy
- Define “Other Aircraft” column
- Flight Experience matrix needs to be more specific
- Where do unscheduled aircraft fit in?
- Demographic information should be 60+ instead of 60-65

Safety Events Section (Previous 12 Months)

- Text introduction should insert the word “observed” after “flight experienced”
- Needs to be directed to more than just pilots and flight crewmembers
- Aircraft Equipment Problems:
  - —“Experienced an engine fire” does not capture the consistency; there can be a large range of engine fires
  - —Needs to be clarified more on the severity of what aircraft problems would lead to the return to land or diversion
- Actual Or Potential Loss of Control:
  - —Encountered wake turbulence that induced 45 or more degrees of roll; needs to be changed to 30
- Airborne Conflicts:
  - —Not just “nearly” collided, but “actually” collided
  - —Expand bird strike to include volcanic ash, hail, etc.
  - —Take the word “residual” out; maybe replace it with “horizontal” or “vertical”
- ATM Problems:
  - —Write out the acronym
  - —Take out the word nearly; it is redundant
  - —Need to be more specific on whether the ATC clearance you received that resulted in a near collision with terrain or a ground obstruction was followed, corrected, or not heard

Safety Events Section (Previous 30 Days)

- Wrong Place, Wrong Time:
  - —Landed without a clearance is too vague. This happens all day with non-tower airports

Safety Events Section (Contributing Factors and Positive Factors)

- Page too busy
- Should not be an opinion-based questionnaire, we should stick with occurrences and events
- Needs to be more specific
- Review this page more to see if it adds value
- Comments and details section should be broken into the following two categories:
  - — (1) What could be done to enhance survey
  - — (2) Other comments and details

Question: How might we formalize industry, government, and professional organization participation in continuing NAOMS development?

- Create a committee
- Define who the implied users are that would benefit from the data
- Determine what information would be essential to each group to have a better focus
- Data may be too soft; "fringe" data

Question: Would an advisory panel be appropriate?

- They believed it was a premature step
- Maybe a user group

—Doesn't need to include all people that attended workshop

—Should be separate from ASRS Subcommittee

—If NASA is internally assessing this, why form a committee at all?

Other Comments

- Be careful not to collect data we have no use for; concentrate on specifics

Group C

Work Group Discussions

Question: Do you have specific suggestions regarding the conduct of the field trial?

- If our goal is to increase response rate, then cover letter from union would be helpful

Question: Have we adequately addressed issues surrounding data sensitivity and use?

- Feel it has been pretty well covered
- But, when would the database be released so that single incidents couldn't be matched to other databases?
- Desperate for this type of information in a timely manner
- But also will want to link it to other databases for validation, etc.

Question: Could you suggest ways of improving the proposed data collection process?

- Recommend surveying on a monthly basis; need to look at 30-day data to identify trends
- The survey would have to be altered
- Cost concerns
- Scantron or automated response for data collection would be helpful
- Eventual resolution of Web site survey issues

Question: What can we do to maximize participation and response in the field trial and beyond?

- Need to make a commitment to offer feedback to those that are completing the survey
- Suggest a Web site
- Data should be accessible in a timely fashion
- Produce articles to be disseminated to industry for publication in internal documents (also could use Callback and DirectLine)

Question: Do you have suggestions for ways to improve the survey instrument?

Flight Experience Section

- Remove word “air carrier” from spanners
- Use standard classifications of type of operations (column 1) – suggest using FAR 119; needs to be dynamic/flexible with changing FARs
- Use standard categories: light, medium, and heavy
- Define “Other Aircraft” column
- Add lighter-than-air, rotorcraft, etc., now
- As pilot gets older, the flight time may not be as accurate – 100 hours doesn’t mean as much when you have 15,000 hours

  —A range of flight hours might be better (e.g., 10,000-12,000 hrs)

Safety Events Section (Previous 12 Months and Previous 30 Days)

- Instead of using Number of Occurrences column, suggest two columns: one for 30 days, one for 12 months for all questions
- Recommend use of Jon’s categories from his presentation
- Need to document the objectives of each question and how we can use the data
- Would like to gather less serious or “precursor” information to know if something is about to happen (e.g., deviated due to icing)
- Use a fixed reference period (e.g., March 1999 instead of “last 30 days”), so data can be compared over time and with other data sources

  —Does this compromise confidentiality? Overall, the questions will collect good and useful data

Safety Events Section (Contributing Factors and Positive Factors)

- Overall, what is learned from this part if we can’t link anything up?

  —Suggest reformulating this page to target risk areas and understand where to do further research

- As a pilot, I find it sort of difficult (might be the layout). Ask for the most significant rather than circle all that apply

- May want to eliminate the use of the word “aircraft design” and just leave it as “problems”

Question: How might we formalize industry, government, and professional organization participation in continuing NAOMS development?

- Just ask
- Identify organizations that are doing safety analysis

Question: Would an advisory panel be appropriate?

- In the beginning of the program and to help identify topical questions
- Maybe a user group

Other Comments

- Suggestion to get the BTS involved

Appendix 9:
Field Trial Final Results

In April 2000, after all data had been collected, the NAOMS team produced the following final report on field trial results. The results pointed the way toward implementation of the full air carrier (AC) survey.

Source: NAOMS Field Test Results: Implications for Full Project Implementation.

Appendix 9: Field Trial Final Results

NAOMS FIELD TEST RESULTS: Implications For Full Project Implementation

INTRODUCTION

The National Aviation Operational Monitoring Service (NAOMS) field trial was designed to evaluate the feasibility of collecting primary data on aviation safety events from air carrier pilots. Issues needing evaluation before a full-scale survey for air carrier pilots could be initiated included the rate of response, the accuracy and quality of the information collected, most effective recall period, necessary sample size, and the projected cost. Central to all these issues is the selection of the mode of survey application: mail or telephone.

This document provides a summary of the key issues associated with selecting the appropriate mode for full-scale implementation of NAOMS for the air carrier pilot community and the appropriate recall period. Each issue is addressed separately and the implications for each mode provided. A summary matrix of the characteristics of each of these topics by mode is also provided at the end of this document.

MODE SELECTION FACTORS

Completion Rates

One of the more important dimensions of selecting a mode for survey application is the rate of response to the questionnaire (that is, the number of people who complete the questionnaire from the pool of eligible respondents). Usually, higher response rates are better since the basis for conducting a sample based survey is the desire to apply the findings to a larger total population. Generally speaking, a response rate has to exceed 70 percent for the findings to be accepted as representative of the total population. Lower response rates may indicate that a significant portion of the sample (those who chose not to respond) may differ markedly from those who did respond. If so, generalization to the general population from a sample with inadequate responses may be erroneous. This was a concern in the NAOMS field trial. If response rates were low, it might have been due to the fact that those pilots were more prone to safety problems and not willing to admit this fact to the researchers. This did not turn out to be a problem.

Table 1. Response Rates By Mode

	Mail	Telephone
Response Rate	70%	81%

Table 1 presents the response rates by both telephone and mail modes. It should be noted that these response rates did not occur as a result of the first contact with the survey respondents. For most respondents, more than one request was required before a successful interview was completed regardless of mode. Additional contact was required because the pilots did not respond to earlier requests, had scheduling conflicts, lost the original mailing, etc.

Data Quality

The quality of data collected is also an important consideration when evaluating what mode of survey should be selected. A high response rate is not of much value if questions are not completed accurately. There are a number of approaches to evaluating data quality, each of which is presented below.

Time for Questionnaire Completion

Evaluation of the time needed to complete the interview is a relative measure of data quality. The underlying assumption is that the more time a respondent takes to complete a questionnaire, the better the quality of the resulting data. Table 2 provides the key data.

Table 2. Questionnaire Mean Completion Time (Minutes)

	Mail	Telephone
Completion Time	17	29

As can be seen, the average time to complete the telephone interview took 12 minutes more (70 percent more) to complete than the mail mode. Some of this difference may be due to the need for the respondent to listen and then assimilate what the interviewer asked in the telephone interview verses the ability of the respondent to quickly read the question in the mail interview. It is unlikely, however, that this explanation explains all the difference in average completion time for the two modes. The lesser amount of time needed to complete the interview when conducted by mail may be indicative of pilots working through the questionnaire quickly, thereby paying less attention to questions or spending less time trying to accurately recall the events.

Missing Responses

Another way to evaluate the quality of data reported is to look at the number of missing responses for the questionnaire. Table 3 presents the percentage of respondents that did not complete at least one question in the questionnaire by mode.

Table 3. Respondents Who Failed to Complete at Least One Question

	Mail	Telephone
One or More Missing Answers	4.8%	0.0%

The lack of any missing answers for the telephone mode is due to the fact that each question, when read by the interviewer, requires a response. Since most of the responses to the questions in this survey appropriate received the response of ‘0’ (for incidents that did not occur during the reference period) it is easy to see how respondents would be tempted to skip quickly across questions in the instrument. This would also explain why the mail version of the questionnaire took so much less time to complete than the telephone version. In the mail version, the pilots did not have anyone prompting them to slow down and think about each answer. In contrast, the interviewers during the telephone interview asked the pilot each question in turn. The pilot did not know what question came next so he or she had to listen to the question to understand its meaning and then think to develop a response.

Total Number of Events and Total Hours Flown in the Recall Period

The observed relationship between the reported number of events and the total hours flown in the recall period also provides insight into data quality. If the questionnaire is capturing accurate responses from pilots about the frequency of events they experience, then pilots with more time flight should experience and report a proportionately greater number of events than those pilots who flew fewer hours.

Several quantitative analyses were conducted looking at the association between the number of events reported and the number of hours flown during the recall period. For all such analyses, one would expect to see a positive relationship between the variables if the data are valid (more flight hours should result in greater number of events reported). Further, the tighter this relationship (as evidenced by a coefficient of regression (COR). Higher CORs indicate stronger relationships. Table 4 shows the pertinent findings.

Table 4. Demonstrated Association Between Number of Events Experienced and Hours Flown

Mode	Unstandardized Coefficient of Regression	Significance	Number of Respondents
Mail	.086	p<.001	223
Telephone	.136	p<.001	220

Associations for both modes were positive, indicating that pilot reports of event frequencies corresponded to experience during the recall period. However, data from the telephone mode showed a somewhat higher degree of association between number of events reported and the number of hours flown indicating greater consistency in the data.

Total Number of Events and Number of Days in Recall Period

By similar logic, one would expect respondents who were asked to use longer recall periods to report proportionately more events than those asked to use shorter periods. Table 5 shows the relationships found in the data. Once again, the relationship was positive with both modes, but it was considerably stronger with the telephone mode. This suggests that telephone respondents were working harder to recall events accurately for the longer recall periods.

Table 5. Demonstrated Assocation Between Number of Pilot Reported Events and Recall Period

Mode	Unstandardized Coefficient of Regression	Significance	Number of Respondents
Mail	0.190	P<.001	228
Telephone	0.265	P<.001	220

Recall Period

Another key objective of the NAOMS field trial was to determine the appropriate recall period. There were two primary completing considerations. First, as recall period lengthens, the memory of events weakens. Shorter recall periods promote quality.[1] Second, longer recall periods favor the recollection of more events permitting more events to be uncovered from fewer respondents. Longer recall periods promote cost savings. Respondents were asked to use a variety of recall periods ranging from one week to six months during the field trial. The resulting data has helped NAOMS find the point that provides a reasonable balance between these two considerations.

[1] NAOMS did some earlier experimental work with a group of air carrier pilots who were asked to recall the number of landings made past month. It was discovered that shorter recall periods were more accurate. For routine events like recalling number of landings, accuracy fell off sharply after one week.

Reporter Confidence

One way to address the effect of the various recall periods used during the field trial was to ask the respondents how confident were they in the answers the had provided. The results are summarized in Table 6 [2].

Table 6. Respondent Confidence in Recollection Accuracy by Recall Period

Recall Period	Extremely Confident	Very Confident	Moderate to No Confidence
1 Week	62%	36%	4%
2 Weeks	58%	34%	8%
4 Weeks	47%	39%	14%
2 Months	36%	49%	15%
4 Months	34%	47%	19%
6 Months	29%	44%	27%

It can be seen that the confidence the pilots have in their ability to accurately recall events dropped markedly as the recall periods got longer. However, at 60 days, 85 percent of respondents still indicated that they were either 'Extremely' or 'Very' confident in their recall. This suggests that a 60- or 90-day recall period may strike the best balance between quality considerations and the need to operate NAOMS in an economical manner.

Pilot Comments

The questionnaire allowed pilots to offer free form observations about the questionnaire and the interview process. One recurring suggestion was that the recall period be increased. The majority of these comments came from pilots who were assigned the one- or two-week recall periods. The felt that these periods were too short for them to report events they remembered experiencing that fell outside the recall window.

COSTS

The NAOMS field trial provided an opportunity to strengthen earlier estimates of the cost of doing this work. Cost elements include:

- Project management and administration including OMB interactions
- Time devoted to industry/labor interactions to build and maintain program support
- Development and testing of survey instruments including topical sections
- Development and maintenance of a database to hold survey results
- Survey data collection
    - Mailings and postage (self-administered)
    - Interviewer training and interview time (telephone)
    - Establishing and maintaining respondent tracking programs[3]
- Data analysis
- Deliverables preparation

NAOMS is intended to serve multiple constituencies including air carrier pilots, GA pilots, air traffic controllers, and others. AOMS costs will increase in a linear fashion with the addition of each new participant group. Modest savings in administration, training and database development areas will be

[2] This table was derived from analysis of pilots who completed the survey by either telephone or by mail. Face-to-face interview results were not included.

[3] NAOMS will track whether or not a respondent has completed a written survey or participated in a telephone survey session. It will not maintain any record of the actual responses provided by any participant.

realized when new groups are added. However, these savings will be fully offset by the costs of engaging the new participants in the NAOMS project particularly development of a customized survey instrument. Accordingly, serving two participant groups will be twice as expensive as serving one group, and so on. Table 7 provides high-level estimates of the cost of conducting NAOMS as in ongoing production for a single participant group. The estimates shown cover all direct and allocated costs, but they do not include contractor fees.

Table 7. Estimated Cost of a Fully Operational NAOMS Program for One Participant Group (1999 dollars)

Cost Element	Estimate	Comment
Project Management and Administration and Industry/Labor Interactions	$125K	
Development and Testing of Survey Instruments	$100K	Assumes four sets of topical questions developed and tested on 100 respondents each year
Data system maintenance and administration	$50K	
Data collection, Telephone Data collection, Self-Administered	$408K $322K	4,800 completed interviews @ $85 4,800 completed questionnaires @ $67
Data Analysis and Deliverables Preparation	$200K	Assumes quarterly reports and an annual report
TOTAL (before fee), Telephone	**$883K**	
TOTAL (before fee), Self-Administered	**$797K**	

OTHER NATIONAL DATA COLLECTION SYSTEMS

Telephone interviewing is the preferred method for many government survey programs. Most of the remaining long-term government data gathering efforts use the face-to-face mode despite its higher cost to maximize data quality. The underlying rationale is that improved data quality is worth the higher data collection costs. Examples of survey efforts that use the phone mode include:

- Survey of Income and Program Participation (Census Bureau) 1984 –
- Consumer Expenditure Surveys (Census Bureau) 1968 –
- Annual Housing Surveys (Census Bureau) 1973 –
- Consumer Attitudes and Behavior (SRC) 1953 –
- Health and Nutrition Examination Surveys (NCHS) 1959 –
- National Health Interview Surveys (NCHS) 1970
- American National Election Studies (NSF) 1948 –
- Panel Study of Income Dynamics (NSF) 1968 –

Many firms compete to provide support services to the government for these programs. Examples include: the Gallup Organization, Westat, SPSS Services, Research Triangle Institute, and Mathematica to name just a few.

CONCLUSIONS AND RECOMMENDATIONS

The NAOMS field trial was a highly successful undertaking that shed light on many methodological issues. The following paragraphs summarize NAOMS team recommendations for implementing the full NAOMS system. The recommendations are based on the field trial results, input from senior survey methodologists, and aviation safety domain experts.

Survey Mode

The weight of the evidence proceeding from the NAOMS field trial strongly suggests that telephone is the preferred NAOMS data collection mode. All data indicators suggest that the data collected by phone will be of substantially higher quality and will have few inappropriate outlier values (due to question misinterpretations, etc.) that have the potential for confounding NAOMS data analyses. The literature also suggests that the telephone mode will consistently yield better quality data than self-administered surveys. This is the reason that most federal agencies that have implemented long-term survey data collection efforts have chosen to use face-to-face or telephone modes.

Recall Period

The literature on survey methodology and theoretical considerations favor a shorter recall periods when accuracy is a paramount concern. On the other hand, longer recall periods would be expected to result in higher observation rates and potentially more economical data collection. It is clear from the NAOMS field trial data that data accuracy declined as recall periods were extended. The fall-off in participant confidence in the accuracy of their responses was particularly noticeable when the recall period was lengthened from two to four weeks. However, when the recall period was further extended from one to four months, the decline in respondent confidence was relatively small. In fact, more than 80 percent of respondents said that they were “extremely or very” confident in their inputs when a four-month recall period was used.

Since NAOMS research has been inconclusive on this issue, a split design is recommended for the first year of implementation. Under this design, half of all respondents would be asked to use a 30-day recall period; the other half would be asked to use a 90-day period. The data would then be evaluated at the end of one year. If the longer 90-day recall period does not appear to material compromise data quality, it should be adopted since it is the more economical approach. Otherwise, the 30-day recall period would be preferred.

Random Versus Panel Design

The field trial itself did not address the issue of random versus panel designs. The literature indicates that a purely random approach is statistically optimal. It is usually easier to administer random designs as well. However, the domain experts on the Team tend to prefer the panel approach. The rationale underlying the NAOMS effort is that the aviation community – pilots, controllers, mechanics, flight attendants, and others – are a highly professional and generally well educated group who can be enlisted as active monitors of NAS safety. It is further believed that enrollment in NAOMS panels will cause participants to become even more acute observers of aviation system safety.

These competing considerations also suggest that a split design would be desirable in Year 1 of the NAOMS implementation. One half of data collection could be accomplished using a pure random sample with a 30-day recall period. The other half could employ a panel design with a 90-day recall period. Each panel respondent[4] would be asked to enroll for one-year period with the expectation that he/she would be asked to participate in four surveys spaced at three-month intervals.

Sample Size

An annual sample size of 4,800 observations (400 per month) is recommended. While a larger sample size would give both greater precision and accuracy, a sample of 4,800 should be sufficient to detect relatively modest downward or upward trends in the occurrence of infrequently occurring aviation safety events.

[4] Some participants in the first year would be asked to enroll for several additional quarters so that one-fourth of panel participants could be replaced each quarter beginning in Year 2.

Appendix 10: Workshop 2

Workshop 2 was held on March 1, 2000, in Washington, DC. Its purpose was to update stakeholders on progress being made toward NAOMS implementation, especially the results of the field trial. During the workshop, the participants formed breakout groups and provided comments, questions, and recommendations to the NAOMS team.

This appendix contains the workshop agenda and attendance list, as well as feedback from workshop participants.

Source: NAOMS Conference Agenda, March 2000.
NAOMS Workshop Attendee List (Workshop 2).

Workshop 2

Agenda and Participants

Workshop 2 Agenda

8:00 to 8:30 A.M.	Registration
8:30 to 9:00 A.M.	Welcome and Opening Comments Introduction of NAOMS Team & Workshop Goals Linda Connell, NASA Project Manager
9:00 to 10:00 A.M.	Project Background: Goals, Development and Experimental Work, Questionnaire Development Robert Dodd, Sc.D., Project Manager, Dodd and Associates
10:00 to 10:15 A.M.	Break
10:15 to 11:00 A.M.	Conducting the NAOMS Field Trial Joan Cwi, Ph.D., Battelle
11:00 to Noon.	Field Trial Trial Findings: Mode Effects and Recall Periods Jon Krosnick, Ph.D., Ohio State University
Noon to 1:00 P.M.	Lunch
1:00 to 2:00 P.M.	Field Trial Findings: Feedback from Participants Elisa Ingebretson, Research Scientist, Battelle
2:00 to 2:30 P.M.	Next Steps Linda Connell, NASA Project Manager
2:30 to 3:00 P.M.	Break
3:00 to 4:45 P.M.	Discussions
4:45 to 5:00 P.M.	Summary and Closing Comments Linda Connell, NASA Project Manager
5:00 P.M.	Adjourn

Workshop 2 Attendance List

FIRST NAME	LAST NAME	ORGANIZATION	OFFICE	JOB TITLE
Ralph	A'Harrah	NASA	Office of Aerospace Technology	Goal Manager, Aviation Safety
Jim	Burin	Flight Safety Foundation		Director of Technical Programs
Doug	Carr	NBAA	Domestic Operations	Manager
Linda	Connell	NASA ARC; 262-7		Director Aviation Safety Reporting System
Mary	Connors	NASA ARC; 262-4	NASA Aviation Safety Program	
Joan	Cwi	Battelle		Director of Survey Operations
Robert	Dodd	Dodd and Associates		Principal Investigator
Bill	Edmunds	ALPA		Human Performance Specialist
Ray	Fenster	Fenster	Information Overload Corporation	
Charles	Fluet	Federal Aviation Administration	Office of Integrated Safety Analysis	Deputy Director
Michael	Ganley	Airbus Industrie of North America		
Larry	Hackler	Federal Aviation Administration AAR-424	Technical Center	
Charles	Harrison	Federal Aviation Administration ASW-110	Rotorcraft Directorate	
Chris	Hart	Federal Aviation Administration, ASY-1	Office of System Safety	Assistant Administrator for System Safety
Chuck	Hedges	Federal Aviation Administration ASY-300	Office of System Safety	Manager, Systems Safety Engineering & Analysis Division
Priscilla	Hospers	Battelle	ASRS	
Elisa	Ingebretson	Battelle	ASRS	Research Scientist
Mike	Jobanek	Florida Technical		Aviation Domain Consultant
Ray	King	HQ Air Force	Safety Center	AFSC/SEPR
Jon	Krosnick	Ohio State University	Department of Psychology (Social)	

FIRST NAME	LAST NAME	ORGANIZATION	OFFICE	JOB TITLE
Mike	Lewis	NASA Langley Research Center	Aviation Safety Program Office	
Harkey	Mayo	FAA ASY-100	Office of System Safety	Data Systems Manager
Tom	Nesthus	Federal Aviation Administration	Civil Aeromedical Institute	
Albert	Prest	Air Transport Association		
Loren	Rosenthal	Battelle		
Mike	Schanck	General Aviation Manufacturers Organization		Safety Affairs and Operations Manager
Vincent	Schultz	NASA Langley Research Center		Program Manager
Nan	Shellabarger	Federal Aviation Administration	Office of Aviation Policy and Plans	
Michael	Silver	Ohio State University	Department of Psychology (Social)	
Stan	Smith	National Transportation Safety Board	Data Systems	Manager
Lee	Snowberger	Conwal		Program Manager
Arthur	Salomon	Federal Aviation Administration APO-110	NASA Aviation Safety Program	
Irv	Statler	NASA	NASA Aviation Safety Program	
Bruce	Tesmer	Continental Airlines	Flight Crew Performance	Captain, Manager
Jim	Varsel	International Association of Machinists and Aerospace Workers		Assistant Airline Coordinator
Carla	Winkler	International Association of Machinists and Aerospace Workers		
Dick	Wright	Helicopter Association International	Safety and Flight Operations	Director
Brien	Wygle	Aerospace Industries Association, Retired	Boeing, Subcommittee	Chairman ASRS

Workshop 2

Feedback from Workshop Participants

Survey Content

- In Section A, regarding the potential inclusion of International Operations, item A3 should be redesigned to avoid errors. A distinction should be made between domestic and international flying, especially regarding ATC and language problems with international ATC.
- Consider adding autorotation/emergency procedures added if you are going to look at rotorcraft operations.
- Consider adding “execute emergency procedure” to list of events.
- Consider adding autorotation to list of events for helicopter pilots.
- Regarding FC4 and 5 (sterile cockpit), different companies and the government have different regulations about sterile cockpit and flight time/duty time restrictions. Clarify in the questionnaire what is being asked about.
- Consider having a question that doesn't constrain the respondent to a recall period but instead allows him to report on any life-changing event that may have occurred in his career.
- Make sure unions are involved in the development of items for all future questionnaires.
- Was a fault tree analysis used to look at causal factors? Use a “fault tree approach” to identify item types for future surveys.
- How flexible are the responses allowed to be? For example, if the recall period is four weeks, but a pilot experienced something 4.5 weeks ago that he/she wants to report, how can the pilot report that?
- Include government flight operations (FAA, etc.) in future surveys.
- What does “engine exhaust” refer to in the Main Events section?
- Consider adding a question about “loss of situational awareness.”

Data Protection

- How is NASA going to protect the data?
- When will data be released?
- Will the data be indefinitely confidential?
- The FAA’s new Advisory Circular could potentially cover the pilots. NASA could protect the data as a “research instrument” for a while. Others could help NASA analyze the data when it is ready for manipulation.

- How did NASA decide on the specific MEL and ICAC questions and sections?
- Consider using the safer skies model for topical sections.
- CAST could help to develop ideas for topical sections. Consider making a presentation to CAST.

Other Comments

- The FAA's General Aviation survey work could help the NAOMS team, and vice versa.
- Will there be more workshops in the out years?

Appendix 11: Air Carrier Questionnaire

Interviewing of the air carrier (AC) pilots began in March 2001. The initial interview sample was split between pilots who were randomly selected for one interview and pilots who were asked to complete the interview once every three months. This appendix includes a copy of the AC questionnaire. The questionnaire consisted of four sections that corresponded with general topics covered in the general aviation (GA) questionnaire: Section A addressed pilot qualifications and experience; Section B addressed safety events; Section C addressed a specific focus topic*; and Section D offered pilots an opportunity to provide feedback on the interview process and the questionnaire. This appendix contains a copy of the air carrier questionnaire.

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* Two Section Cs were prepared during the course of this survey: one pertains to In-close Approach Changes (ICACs), and the other pertains to the development of baseline safety for the CAST-JIMDAT.

Source: Battelle Centers for Public Health Research and Evaluation (CPHRE).

Air Carrier Questionnaire

Section A:
Background Questions

TIME BEGUN ....(MILITARY) ....|__|__| : |__|__|
(FILLS)

INTERVIEWER: DATE OF INTERVIEW IS BEING RECORDED AS (START DATE).
IS THIS THE CORRECT DATE?

YES..1
NO .... (RECORD DATE OF INTERVIEW) 0

START DATE ....|__|__| / |__|__| / |__|__|
MONTH DAY YEAR

....S
TART DATE = 30/90 DAYS BEFORE END DATE

END DATE ....|__|__| / |__|__| / |__|__|
(FILLS) MONTH DAY YEAR

END DATE = DAY
BEFORE DAY OF INTERVIEW

SECTION A: BACKGROUND QUESTIONS

INTRODUCTION:

For this survey most of the questions will refer to (30/90) days prior to today. Therefore, whenever I say the "last (TIME PERIOD), I am referring to the period from (START DATE) through (END DATE).

I am now going to ask you a few questions about the commercial flying that you did during the last (TIME PERIOD).

A1. During the last (TIME PERIOD), how many **hours** did you fly as a crewmember on commercial aircraft?

HOURS IN TIME PERIOD...|__|__|__|

PROMPT IF 30 DAYS>100, 90 DAYS>300*: I'd just like to verify. You said you flew (HOURS A1) hours during the last (TIME PERIOD) as a crewmember on a commercial aircraft. Is this correct?*

NO...0
YES.. (A2)..1
RF.. (A2)..7
DK.. (A2)..8

A1 *NEW* *During the last (TIME PERIOD), how many hours did you fly as a crewmember on a commercial aircraft?*

 # HOURS ....|__|__|__|
RF.. 997
DK.. 998

A2. During the last (TIME PERIOD), how many **legs** did you fly as a crewmember on commercial aircraft?

LEGS IN TIME PERIOD.. |_|_|_|

A2.1 During the last (TIME PERIOD), how many of the (#A2) legs you flew involved taking off or landing at an airport outside the United States?

NOTE: THE UNITED STATES MEANS THE 50 STATES AND WASHINGTON DC, BUT DOES NOT INCLUDE US TERRITORIES.

LEGS OUTSIDE U.S. .... |_|_|_|

NUMBER OF LEGS IN A2.1 MUST BE LESS THAN OR EQUAL TO LEGS IN A2.

A3. Please tell me the makes, models and series for all of the aircraft you flew commercially as a crewmember during the last (TIME PERIOD)? RECORD VERBATIM IN COLUMN A, THEN ASK PROMPT.

PROMPT A3_A1: Did you fly any other makes, models or series of aircraft commercially during the last (TIME PERIOD)?	*YES.............................. (ASK PROMPT A3_A2)..1* *NO..(ASK B) ....0* *RF...7* *DK..8*

PROMPT A3_A2: Please tell me the next aircraft make, model and series you flew commercially as a crewmember during the last (TIME PERIOD)? RECORD IN COLUMN A

A. MAKE/MODEL/SERIES (NOTE; MAKE/MODEL/SERIES DROP DOWN SCREEN INCREASED WITH THIS VERSION)	B. During the last (TIME PERIOD), what **percent** of the (HRS IN A1) did you fly the (MAKE/ MODEL/SERIES)?
1st ____________	|_|_|_| %
2nd ____________	|_|_|_| %
3rd ____________	|_|_|_| %
4th ____________	|_|_|_| %
5th ____________	|_|_|_| %
6th ____________	|_|_|_| %
	THE TOTAL PERCENT OF A3-B SHOULD BE 100.

INTRODUCTION:
During the last (TIME PERIOD), you may have transported passengers or cargo, or conducted other flight operations. We would like to understand what types of operations you flew.

A4. During the last (TIME PERIOD), what percent of the (HRS IN A1) did you fly as a crewmember on flights with revenue passengers?

% WITH REVENUE PASSENGERS.................................... |__|__|__|

A5. During the last (TIME PERIOD), what percent of the (HRS IN A1) did you work as a crewmember on flights that carried only cargo or freight and did **not** carry revenue passengers?

% CARGO/FREIGHT W/O PASSENGERS .... |__|__|__|

A6. During the last (TIME PERIOD), what percent of the (HRS IN A1) did you work as a crewmember on flights that carried no revenue passengers or cargo, such as maintenance flights, ferry flights, or repositioning flights?

% NO PASSENGER OR CARGO .... |__|__|__|

THE TOTAL PERCENT OF A4, A5, AND A6 SHOULD BE 100.

A. What type of flights were these?

SPECIFY: ______________________________

A7. During the last (TIME PERIOD), did you fly a commercial aircraft (READ QUESTIONS)?

	YES	NO	RF	DK
a. as a captain...	1	0	7	8
b. as a first officer..	1	0	7	8
c. as a flight engineer or second officer.....................	1	0	7	8
d. as a relief pilot..	1	0	7	8
e. in any other capacity (SPECIFY).............................	1	0	7	8

1. What was that capacity?

A7a THROUGH A7e CANNOT ALL BE ANSWERED NO.

SPECIFY: ______________________________

INTERVIEWER: CAN INCLUDE CHECK PILOT.

A7.1 Which of the following three categories best describes the number of airplanes currently operated by your airline? Please do not include airplanes operated by code-share partners. READ CATEGORIES.

350 airplanes or more	1
150 to 349 airplanes	2
149 or less airplanes	3
RF	7
DK	8

NOTE: WE ARE ONLY INTERESTED IN AIRPLANES CURRENTLY BEING USED, NOT THOSE IN STORAGE.

PROBE IF PILOT FLEW FOR MORE THAN ONE AIRLINE IN TIME PERIOD: Please tell me the number of airplanes currently operated by the airline **that you flew the most hours for** in the last (TIME PERIOD).

A8. Approximately how many **hours** in total have you flown a **commercial aircraft during your career**?

TOTAL HOURS DURING CAREER................ |__|__|__|__|__|

Air Carrier Questionnaire

Section B:
Safety Related Events

SECTION B: SAFETY RELATED EVENTS

INTRODUCTION:

My next questions are about safety related events. In answering these questions, please report only events that **you experienced on a commercial aircraft on which you were a crewmember**. The first of these questions are about **equipment-related events.**

ER1. How many times during the last (TIME PERIOD) did an aircraft on which you were a crewmember divert to an alternate airport or return to land because of an aircraft equipment problem?

EQUIPMENT PROBLEMS....................................... |__|__|__|

A. What systems caused the diversion or return to land?

SPECIFY: ____

ER2. How many times during the last (TIME PERIOD) did an aircraft on which you were a crewmember experience a spill, fire, fumes, or aircraft damage due to transporting hazardous materials?

HAZMAT .... |__|__|__|

IF 0, SKIP TO ER3.

A. (How many of these [# in ER2] times were the spills, fire, fumes or aircraft damage/Was this spill, fire, fumes or aircraft damage) in the cargo compartment?

IN CARGO COMPARTMENT .... |__|__|__|

THE AMOUNT IN ER2A CANNOT BE GREATER THAN THE AMOUNT IN ER2.

B. (How many of these [# in ER2] times were spills, fire, fumes or aircraft damage/Was this spill, fire, fumes or aircraft damage) in the passenger compartment?

IN PASSENGER COMPARTMENT.......................... |__|__|__|

THE AMOUNT IN ER2A AND ER2B COMBINED CANNOT BE GREATER THAN THE AMOUNT IN ER2.

C. (How many of these [# IN ER2] times were the spills, fire, fumes or aircraft damage/Was the spill, fire, fumes or aircraft damage) caused because the hazardous materials in question were out of compliance with regulations?

OUT OF COMPLIANCE WITH REGULATIONS ...... |__|__|__|

THE AMOUNT IN ER2C CANNOT BE GREATER THAN THE AMOUNT IN ER2.

ER3. How many times during the last (TIME PERIOD) did an aircraft on which you were a crewmember experience a cargo shift

CARGO SHIIFTS.. |__|__|__|

ER4. How many times during the last (TIME PERIOD) did an in-flight aircraft on which you were a crewmember experience uncommanded movements of any of the following devices (READ QUESTIONS)?

a. Uncommanded movements of the elevators? .... # ELEVATORS .... |__|__|__|

b. Uncommanded movements of the rudder? .... # RUDDER .... |__|__|__|

c. Uncommanded movements of the ailerons? .... # AILERONS .... |__|__|__|

d. Uncommanded movements of the spoilers? .... # SPOILERS .... |__|__|__|

e. Uncommanded movements of the speedbrakes? . # SPEEDBRAKERS .... |__|__|__|

f. Uncommanded movements of the trim tabs? .... # TRIM TABS .... |__|__|__|

g. Uncommanded movements of the flaps? .... # FLAPS .... |__|__|__|

h. Uncommanded movements of the slats? .... # SLATS .... |__|__|__|

i. Did any other devices have uncommanded movements during the last (TIME PERIOD)?

YES 1
NO .... (SKIP TO ER5) 0
RF .... (SKIP TO ER5) 7
DK .... (SKIP TO ER5) 8

1. Which devices?

SPECIFY: ____________________

2. **FOR EACH DEVICE LISTED IN ER4i1:** How many times did (DEVICE LISTED IN ER4i1) perform uncommanded movements during the last (TIME PERIOD)?

UNCOMMANDED MOVEMENTS .... |__|__|__|

ER5. How many times during the last (TIME PERIOD) did an inflight aircraft on which you were a crewmember experience smoke, fire, or fumes that originated in any of the following areas (READ QUESTIONS):

A. the engine or nacelle? .... # IN ENGINE OR NACELLE .... |__|__|__|

IF 0, SKIP TO ER5B.

1. (Of the [# in ER5A] times there was smoke, fire, or fumes in the engine or nacelle, how many involved/Did the smoke, fire, or fumes in the engine or nacelle involve) electrical components or wiring?

SMOKE/FIRE/FUMES .... |__|__|__|

THE AMOUNT IN ER5A1 CANNOT BE GREATER THAN THE AMOUNT IN ER5A.

B. the flight deck? .... # IN FLIGHT DECK .... |__|__|__|

IF 0, SKIP TO ER5C.

1. (Of the [# in ER5B] times there was smoke, fire, or fumes in the flight deck, how many involved/Did the smoke, fire, or fumes in the flight deck involve) electrical components or wiring?

SMOKE/FIRE/FUMES .... |__|__|__|

THE AMOUNT IN ER5B1 CANNOT BE GREATER THAN THE AMOUNT IN ER5B.

C. the cargo hold?.. # IN CARGO HOLD.. |__|__|__|

IF 0, SKIP TO ER5D.

1. (Of the [# in ER5C] times there was smoke, fire, or fumes in the cargo hold, how many involved/Did the smoke, fire, or fumes in the cargo hold involve) electrical components or wiring? SMOKE/FIRE/FUMES.. |__|__|__|

THE AMOUNT IN ER5C1 CANNOT BE GREATER THAN THE AMOUNT IN ER5C.

D. the galley? .... # IN GALLEY... |__|__|__|

IF 0, SKIP TO ER5E.

1. (Of the [# in ER5D] times there was smoke, fire, or fumes in the galley, how many involved/Did the smoke, fire, or fumes in the galley involve) electrical components or wiring? SMOKE/FIRE/FUMES.. |__|__|__|

THE AMOUNT IN ER5D1 CANNOT BE GREATER THAN THE AMOUNT IN ER5D.

E. elsewhere in the passenger compartment? ...... # IN ELECTRICAL COMPONENETS OR WIRING ..... |__|__|__|

IF 0, SKIP TO ER5F.

1. (Of the [# in ER5E] times there was smoke, fire, or fumes elsewhere in the passenger compartment, how many involved/Did the smoke, fire, or fumes elsewhere in the passenger compartment involve) electrical components or wiring? SMOKE/FIRE/FUMES.. |__|__|__|

THE AMOUNT IN ER5E1 CANNOT BE GREATER THAN THE AMOUNT IN ER5E.

F. During the last (TIME PERIOD), how many times did an inflight aircraft on which you were a crewmember experience smoke, fire or fumes that originated other than in the engine or nacelle, flight deck, cargo hold, galley, or passenger compartment? # ORIGINATE OTHER PLACES............................. |__|__|__|

1. Where did the smoke, fire or fumes originate? SPECIFY.

SPECIFY: ____________________________

ER6. During the last (TIME PERIOD), how many times did an inflight aircraft on which you were a crewmember experience a precautionary engine shutdown? # PRECAUTIONARY ENGINE SHUTDOWNS........... |__|__|__|

ER7. During the last (TIME PERIOD) how many times did an inflight aircraft on which you were a crewmember experience a total engine failure? # TOTAL ENGINE FAILURE...................................... |__|__|__|

INTRODUCTION:

The following questions relate to **turbulence**.

During the last (TIME PERIOD), how many times did an aircraft on which you were a crewmember (READ QUESTION)?

TU1. Encounter severe turbulence that caused large abrupt changes in altitude, airspeed, or attitude .. # CAUSED ABRUPT CHANGES................................ |__|__|__|

IF 0, SKIP TO TU2.

A. (Of the [#in TU1] severe turbulence encounters, how many occurred/Did this severe turbulence encounter occur) in I.M.C. conditions? I.M.C. = INSTRUMENT METEOROLOGICAL CONDITIONS

IN IMC CONDITIONS .... |__|__|__|

THE AMOUNT IN TU1A CANNOT BE GREATER THAN THE AMOUNT IN TU1.

B. (Of the [# in TU1] severe turbulence encounters, how many occurred/Did this severe turbulence encounter occur) in clear air?

IN CLEAR AIR .... |__|__|__|

THE AMOUNT IN TU1A AND TU1B CANNOT BE GREATER THAN THE AMOUNT IN TU1.

TU2. Encounter wake turbulence that resulted in 10 or more degrees of aircraft roll .... # RESULTING IN AIRCRAFT ROLL .... |__|__|__|

INTRODUCTION:

The next few questions are about **weather-related events while airborne**.

During the last (TIME PERIOD), how many times did an aircraft on which you were a crewmember (READ QUESTION)?

WE1. Lack accurate weather information when crewmembers needed it while airborne .... # LACK WEATHER INFORMATION........................... |__|__|__|

IF 0, SKIP TO WE2.

A. (Of the [# WE1] times when crewmembers lacked accurate weather information while airborne, how many involved non-U.S. airports or controllers?/ Did this time when crewmembers lacked accurate weather information while airborne involve a non-U.S. airport or controller?)

INVOLVE NON-US AIRPORT OR CONTROLLER ... |__|__|__|

THE AMOUNT IN WE1A CANNOT BE GREATER THAN THE AMOUNT IN WE1.

B. (Of the [# WE1] times when crewmembers lacked accurate weather information while airborne, how many involved ATIS?/Did this time when crewmembers lacked accurate weather information while airborne involve ATIS?)

INVOLVE ATIS.. |_|_|_|

THE AMOUNT IN WE1A AND WE1B COMBINED CANNOT BE GREATER THAN THE AMOUNT IN WE1.

WE2. Fail to receive A.T.C. approval for a request to avoid severe weather ....

FAIL RECEIVE ATC APPROVAL.............................. |_|_|_|

IF 0, SKIP TO WE3.

A. (Of the [# WE2] times crewmembers failed to receive A.T.C. approval to avoid severe weather, how many times was emergency authority invoked in these situations/Was emergency authority invoked in this situation?

EMERGENCY AUTHORITY INVOKED……………..... |_|_|_|

THE AMOUNT IN WE2A CANNOT BE GREATER THAN THE AMOUNT IN WE2.

WE3. Divert to an alternate airfield because of weather ....

DIVERT TO ALTERNATE AIRFIELD .... |_|_|_|

WE4. Experience airframe icing that reduced the aircraft's ability to maintain altitude, speed, stability, or directional control..

EXPERIENCE AIRFRAME ICING............................. |_|_|_|

WE5. Encounter windshear or a microburst condition that resulted in an airspeed deviation of 15 knots or greater..

ENCOUNTER WINDSHEAR/MICROBURST .... |_|_|_|

WE6. Encounter windshear or a microburst condition that resulted in a windshear avoidance maneuver ....

RESULT IN WINDSHEAR AVOIDANCE................... |_|_|_|

IF A4=0, SKIP TO AC1.

INTRODUCTION:

The next few questions are about **passenger-related events**.

During the last (TIME PERIOD), how many times did an **in-flight** aircraft on which you were a crewmember (READ QUESTIONS):

CP1. Expedite landing or divert to an alternate airport due to a passenger medical emergency.................

DUE TO PASSENGER MEDICAL EMERGENCY..... |_|_|_|

CP2. Expedite landing or divert to an alternate airport due to a passenger disturbance.................................

DUE TO PASSENGER DISTURBANCE .... |_|_|_|

CP3. During the last (TIME PERIOD), how many times did a crewmember leave the cockpit to handle a passenger disturbance on an inflight aircraft on which you were a crewmember ....

CREWMEMBERS LEAVE COCKPIT .... |_|_|_|

INTRODUCTION:

The next few questions are about **airborne conflicts**.

During the last (TIME PERIOD), how many times did an aircraft on which you were a crewmember (READ QUESTION)?

AC1.	Experience a bird strike..	# BIRD STRIKES .... |_|_|_|
AC2.	Perform an evasive action to avoid an imminent in-flight collision with another aircraft that was never closer than 500 feet including evasive action in response to a TCAS advisory?	# EVASIVE ACTIONS.. |_|_|_|
AC3.	Experience less than 500 feet of separation from another aircraft while both aircraft were airborne	# LESS THAN 500 FEET SEPARATION .... |_|_|_|

INTRODUCTION:

The next few questions are about **ground operations**.

During the last (TIME PERIOD), how many times did an aircraft on which you were a crewmember (READ QUESTION)?

GE1.	Go off the edge of a runway or taxiway while taxiing	# GO OFF EDGE RUNWAY/TAXIWAY .... |_|_|_|
GE2.	Collide or nearly collide with a ground vehicle?.......	# COLLIDE WITH GROUND VEHICLE........................ |_|_|_| **IF 0, SKIP TO GE3.**
	A. (Of the [# in GE2] near collisions with a ground vehicle, how many occurred/Did this near collision with a ground vehicle occur) while your aircraft was on the ramp, apron or in the gate area?	# ON RAMP/APRON/GATE AREA .... |_|_|_| ***THE AMOUNT IN GE2A CANNOT BE GREATER THAN THE AMOUNT IN GE2.***
	B. (Of the [# in GE2] near collisions with a ground vehicle, how many occurred/Did this near collision with a ground vehicle occur) while your aircraft was on the taxiway?	# ON TAXIWAY... |_|_|_| ***THE AMOUNT IN GE2A AND GE2B COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE2.***
	C. (Of the [# in GE2] near collisions with a ground vehicle, how many occurred/Did this near collision with a ground vehicle occur) while your aircraft was on the runway?	# ON RUNWAY... |_|_|_| ***THE AMOUNT IN GE2A, GE2B, AND GE2C COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE2.***
GE3.	Skid, slide, or hydroplane resulting in a significant increase in stopping distance during landing...........	# SKID/SLIDE/HYDROPLANE .... |_|_|_|
GE4.	Experience a rejected takeoff..................................	# REJECTED TAKEOFFS .... |_|_|_|

GE5.	Go off the edge of a runway while taking off or landing........	# GO OFF EDGE OF RUNWAY........ |_|_|_|
GE6.	Go off the end of the runway........	# GO OFF END OF RUNWAY........ |_|_|_|
GE7.	Inadvertently enter an active runway........	# ENTER ACTIVE RUNWAY........ |_|_|_|
GE8.	Begin takeoff roll while another aircraft occupied or was crossing the same runway........	# TAKEOFF ROLL WITH OCCUPIED RUNWAY........ |_|_|_|
GE9.	Land while another aircraft occupied or was crossing the same runway........	# LAND ON OCCUPIED RUNWAY........ |_|_|_|
GE10.	Nearly experience a ground collision with another aircraft while both aircraft were on the ground........	# NEAR GROUND COLLISION........ |_|_|_| **IF 0, SKIP TO AH1.**
	A. (Of the [# in GE10] near collisions with another aircraft, how many occurred/Did this near collision with another aircraft occur) while your aircraft was on the ramp, apron or in the gate area?	# ON RAMP/APRON/GATE AREA........ |_|_|_| ***THE AMOUNT IN GE10A CANNOT BE GREATER THAN THE AMOUNT IN GE10.***
	B. (Of the [# in GE10] near collisions with another aircraft, how many occurred/Did this near collision with another aircraft occur) while your aircraft was on the taxiway?	# ON TAXIWAY........ |_|_|_| ***THE AMOUNT IN GE10A AND GE10B COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE10.***
	C. (Of the [# in GE10] near collisions with another aircraft, how many occurred/Did this near collision with another aircraft occur) while your aircraft was on the runway?	# ON RUNWAY........ |_|_|_| ***THE AMOUNT IN GE10A, GE10B, AND GE10C COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE10.***

INTRODUCTION:

The next few questions are about **aircraft handling-related events.**

During the last (TIME PERIOD), how many times did an aircraft on which you were a crewmember (READ QUESTION)?

AH1.	Use some of its reserve fuel as defined by the F.A.Rs........	# USE RESERVE FUEL........ |_|_|_|
AH2.	Accept an A.T.C. clearance that the aircraft could not comply with because of its performance limits........	# ACCEPT CLEARANCE NOT COMPLY WITH........ |_|_|_|
AH3.	Lose sight of another aircraft from which the aircrew was trying to maintain visual separation	# LOSE SIGHT OF AIRCRAFT........ |_|_|_| **IF 0, SKIP TO AH4.**
	A. (Of the [# in AH3] times an aircraft lost sight of another aircraft, how many occurred/Did losing sight of another aircraft occur) in marginal visual conditions of 3 miles or less?	# IN MARGINAL VISUAL CONDITONS........ |_|_|_| ***THE AMOUNT IN AH3A CANNOT BE GREATER THAN THE AMOUNT IN AH3.***

AH4. Inadvertently land without clearance at an airport with an active control tower........................ # LAND W/O CLEARANCE ....

AH5. Inadvertently begin takeoff roll without A.T.C. clearance at an airport with an active control tower.. # TAKEOFF ROLL W/O CLEARANCE.......................

AH6 Inadvertently deviate from an assigned routing or A.T.C. vector for one minute or more.............. # DEVIATIONS ....

AH7. Experience a tail strike on landing......................... # TAIL STRIKES ON LANDING..................................

AH8. Experience a tail strike on takeoff .... # TAIL STRIKES ON TAKEOFF ....

AH9. Experience a hard landing.................................... # HARD LANDINGS..

AH10. Take off with an out-of-limit center of gravity......... # TAKE-OFF OUT-OF-LIMIT CENTER OF GRAVITY

AH11. Take-off overweight .... # TAKE-OFF OVERWEIGHT.....................................

AH12. Commence take-off roll with an improper aircraft configuration .... # WITH IMPROPER CONFIGURATION.....................

AH13. Experience an unusual attitude for any reason.. # UNUSUAL ATTITUDE ....

AH14. Experience a valid stall warning or stick shaker activation.. # STALL WARNING/STICK SHAKER ACTIVATION...

AH15. Nearly collide with terrain or a ground obstruction while airborne?... # NEAR COLLISIONS/GROUND ....

IF 0, SKIP TO AD1.

INTERVIEWER: INCLUDES BUILDINGS

A. (Of the [# in AH15] near collisions with terrain or a ground obstruction, how many were/Was this near collision with terrain or a ground obstruction) brought to your attention by A.T.C.? # ATC BROUGHT TO YOUR ATTENTION ....

THE AMOUNT IN AH15A CANNOT BE GREATER THAN THE AMOUNT IN AH15.

B. (Of the [# in AH15] near collisions with terrain or a ground obstruction, how many were/Was this near collision with terrain or a ground obstruction) detected through direct sighting of the ground or obstruction? # DETECTED THROUGH DIRECT SIGHTING.................

THE AMOUNT IN AH15A AND AH15B COMBINED CANNOT BE GREATER THAN THE AMOUNT IN AH15.

C. (Of the [# in AH15] near collisions with terrain or a ground obstruction, how many were/Was this near collision with terrain or a ground obstruction) detected through activation of G.P.W.S. or E.G.P.W.S.?.......... # DETECTED THROUGH GPWS/EGPWS ....

THE AMOUNT IN AH15A, AH15B, AND AH15C COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE10.

1. (How many of these [# in AH15c] near collisions were/Was this near collision) detected through activation of E.G.P.W.S.? # DETECTED THROUGH ACTIVATION OF EGPWS.

THE AMOUNT IN AH15C1 CANNOT BE GREATER THAN THE AMOUNT IN AH15C.

INTRODUCTION:

The next few questions are about **altitude deviations**.

How many times during the last (TIME PERIOD) did an aircraft on which you were a crewmember (READ QUESTIONS)?

AD1. Inadvertently deviate from an assigned altitude by more than 300 feet?.. # ALTITUDE DEVIATIONS .... |__|__|__|

IF 0, SKIP TO AD2.

A. (Of the [# in AD1] deviations from an assigned altitude, how many were/Was this deviation from an assigned altitude) in response to a TCAS Resolution Advisory? # IN RESPONSE TO TCAS.. |__|__|__|

THE AMOUNT IN AD1A CANNOT BE GREATER THAN THE AMOUNT IN AD1.

AD2. Descend below Minimum Safe Altitude when you were **not** following A.T.C. radar vectors........ # NOT FOLLOWING ATC RADAR VECTORS .... |__|__|__|

INTRODUCTION:

The next few questions are about **interactions with air traffic control**.

AT1. During the last (TIME PERIOD), how many times was an aircraft on which you were a crewmember unable to communicate with A.T.C. in a time-critical situation because of frequency congestion? # UNABLE TO COMMUNICATE WITH ATC .... |__|__|__|

IF 0, SKIP TO AT2.

These problems may have occurred on the ground, or while airborne in the terminal area, or while en route. I'm going to ask you about each.

A. (Of these [# in AT1] times you were unable to communicate with A.T.C. in a time-critical situation because of frequency congestion, how many occurred/Did the time you were unable to communicate with A. T.C in a time critical situation because of frequency congestion occur) **while on the ground**? # WHILE ON GROUND... |__|__|__|

TIMES

THE AMOUNT IN AT1A CANNOT BE GREATER THAN THE AMOUNT IN AT1.

B. (Of these [# in ATI1] times you were unable to communicate with A.T.C. in a time-critical situation because of frequency congestion, how many occurred/Did the time you were unable to communicate with A. T.C in a time critical situation because of frequency congestion occur) **while airborne in the terminal area**? .... # WHILE AIRBORNE .... |__|__|__|

TIMES

THE COMBINED TOTALS IN AT1A AND AT1B CANNOT BE GREATER THAN 100.

C. (Of these [# in ATI1] times you were unable to communicate with A.T.C. in a time-critical situation because of frequency congestion, how many occurred/Did the time you were unable to communicate with A. T.C in a time critical situation because of frequency congestion occur) **while en route**? ....

WHILE EN ROUTE.. |__|__|__|
TIMES

THE COMBINED TOTALS IN AT1A, AT1B, AND AT1C CANNOT BE GREATER THAN 100.

AT2. How many times during the last (TIME PERIOD) did an aircraft on which you were a crewmember fly at an undesirably high altitude or airspeed on approach due to an A.T.C. clearance ....

NOTE TO INTERVIEWERS: THIS INCLUDES BUT MAY NOT BE LIMITED TO "SLAM DUNK" APPROACHES.

HIGH ALTITUDE OR AIRSPEED.............................. |__|__|__|

Air Carrier Questionnaire

Section C:
In-close Approach Changes

SECTION C: IN-CLOSE APPROACH CHANGES

INTRODUCTION:

My next questions are about **clearance changes received on approach** within 10 miles of the runway threshold **that the flight crew did not request**.

IC1. During the last (TIME PERIOD), how many times did an aircraft on which you were a crewmember receive an unrequested clearance change to runway assignment, altitude restrictions or airspeed within 10 miles of the runway threshold?

UNREQUESTED CLEARANCE CHANGES ....|__|__|__|

IF 00, DK OR RF, SKIP TO SECTION D.
IF 01, CONTINUE WITH ROUTE A.
IF 02 OR MORE, SKIP TO ROUTE B.

ROUTE A—ONLY ONE CHANGE

A. Was this unrequested clearance change declined?

YES..........................(SKIP TO SECTION D)..........................001
NO...000
RF............................(SKIP TO SECTION D)..........................997
DK............................(SKIP TO SECTION D)..........................998

B. Did this unrequested clearance change result in (READ QUESTIONS)?

	YES	NO	RF	DK
1. An unstabilized approach.........................	1	0	7	8
2. A go-around or missed approach.............	1	0	7	8
3. An airborne conflict..................................	1	0	7	8
4. A wake turbulence encounter...................	1	0	7	8
5. Landing with out-of-limit tailwinds or crosswinds...	1	0	7	8
6. Landing on a wrong runway	1	0	7	8
7. Landing long or fast..................................	1	0	7	8
8. Landing without clearance	1	0	7	8
9. A conflict on the ground with another aircraft or ground vehicle?.......................	1	0	7	8
10. Any other undesirable event after the clearance change?..................................	1 ASK a.	0	7 SKIP TO IC2.	8 SKIP TO IC2.

a. What events occurred?

SPECIFY: ______________________________

SKIP TO IC2.

ROUTE B—TWO OR MORE CHANGES

A. Of the (# IN IC1) unrequested clearance changes, how many, if any, were declined?

UNREQUESTED CLEARANCE CHANGES .... |__|__|__|

IF NUMBER IN IC1A=NUMBER IN IC1, DK or RF, SKIP TO SECTION D.

IF ONLY ONE CHANGE REMAINS, GO TO ROUTE A, IC1B.

THE NUMBER OF UNREQUESTED CLEARANCE CHANGES WAS (NUMBER IC1) SO THE NUMBER OF UNREQUESTED CLEARANCE CHANGES THAT WERE DECLINED HAS TO BE (NUMBER IN IC1) OR FEWER.

B. How many of the accepted clearance changes resulted in (READ QUESTIONS)? IF 01 OR GREATER, ASK C.

THE ANSWERS IN IC1B 1-10 CANNOT BE GREATER THAN IC1 MINUS IC1A.

C. Did (this/any of these) (EVENT) happen in the most recent **accepted** clearance change?

	# CHANGES	YES	NO	RF	DK
1. An unstabilized approach	|__|__|__|	1	0	7	8
2. A go-around or missed approach	|__|__|__|	1	0	7	8
3. An airborne conflict	|__|__|__|	1	0	7	8
4. A wake turbulence encounter	|__|__|__|	1	0	7	8
5. Landing with out-of-limit tailwinds or crosswinds	|__|__|__|	1	0	7	8
6. Landing on a wrong runway	|__|__|__|	1	0	7	8
7. Landing long or fast	|__|__|__|	1	0	7	8
8. Landing without clearance	|__|__|__|	1	0	7	8
9. A conflict on the ground with another aircraft or ground vehicle?	|__|__|__|	1	0	7	8
10. Any other undesirable event after the clearance change?	|__|__|__|	1 ASK a.	0	7	8
	IF NONE, SKIP TO IC2.IF ≥1, ASK a.		$\underbrace{\quad\quad\quad}_{\text{SKIP TO IC2.}}$		

a. What events occurred?

SPECIFY: ______________________________________

INTRODUCTION:

(My next questions are about **this accepted clearance** change that we have been talking about./My next questions are about the **most recent clearance change** that the flight crew **accepted.**)

IC2. At which airport did this event occur?

NAME OF AIRPORT: ______________________

A. Please tell me the location identifier for (AIRPORT).

AIRPORT LOCATION ID: ______________________

IC3. **ASK ONLY IF TWO OR MORE MODELS REPORTED IN A3. IF ONLY ONE MODEL, SKIP TO IC4.**

Which model aircraft were you flying when this event occurred, the (LIST MODELS IN A3A)? **CODE MODEL FROM A3A**

NAME/MODEL: ______________________

IC4. Were you a crewmember on an F.M.S. or F.M.C. equipped aircraft at the time of this event?

YES....................1
NO ....(SKIP TO IC8)....0
RF ....(SKIP TO IC8)....7
DK ....(SKIP TO IC8)....8

A. Was the F.M.S. or F.M.C. that was being used capable of storing multiple routes?

YES....................1
NO ....(SKIP TO IC8)....0
RF ....(SKIP TO IC8)....7
DK ....(SKIP TO IC8)....8

B. Are the navigation and communication frequency changes in this aircraft made through the F.M.S. or F.M.C.?

YES....................1
NO.....................0
RF.....................7
DK.....................8

IC5. In response to this clearance change, did the flightcrew reprogram or attempt to reprogram the F.M.S. or F.M.C.

YES....................1
NO ....(SKIP TO IC8)....0
RF ....(SKIP TO IC8)....7
DK ....(SKIP TO IC8)....8

IC6. When programming changes were made or attempted, (READ QUESTIONS)?

	YES	NO	RF	DK
A. Did the inputs load properly..............................	1	0	7	8
B. Was it possible to complete the programming within available time	1	0	7	8
C. Were all of the programming inputs cross-checked by other crewmembers?	1	0	7	8
D. Were there other programming difficulties	1 ASK 1.	0	7 SKIP TO IC7.	8

1. Please describe these difficulties.

SPECIFY: ______________________

IC7. Overall, did the F.M.S. or F.M.C. assist you in complying with the clearance change?

YES 1
NO 0
RF 7
DK 8

<u>ONLY IF ROUTE B IC1A IS 2 OR GREATER, READ INTRODUCTION:</u>

INTRODUCTION:

Before we continue, I want to remind you that these questions are still about the **most recent** unrequested clearance change within 10 miles of the runway threshold.

IC8. Was the aircraft on an instrument approach prior to the clearance change?

YES 1
NO .... (SKIP TO IC9) 0
RF .... (SKIP TO IC9) 7
DK .... (SKIP TO IC9) 8

A. Did this change involve a change from an instrument approach to a visual approach?

YES 1
NO .... (SKIP TO IC10) 0
RF .... (SKIP TO IC10) 7
DK .... (SKIP TO IC10) 8

IC9. Did this change involve a change from a visual approach to an instrument approach?

YES 1
NO 0
RF 7
DK 8

IC10. Was the aircraft programmed for an auto-coupled approach at the time of the clearance change?

YES 1
NO 0
RF 7
DK 8
NA 9

IC11. Did this clearance change the aircraft's runway assignment?

YES 1
NO .... (SKIP TO IC12) 0
RF .... (SKIP TO IC12) 7
DK .... (SKIP TO IC12) 8

A. Did the runway reassignment involve a change from one runway to another parallel runway

YES 1
NO 0
RF 7
DK 8

IC12. Did this clearance change the aircraft's altitude assignment?

YES 1
NO 0
RF 7
DK 8

IC13. Did this clearance change the aircraft's airspeed assignment?

YES 1
NO 0
RF 7
DK 8

ONLY IF ROUTE B IC1A IS 2 OR GREATER, READ INTRODUCTION:

INTRODUCTION:

Once again, before we continue, I want to remind you that these questions are still about the **most recent** unrequested clearance change within 10 miles of the runway threshold.

IC14. In response to this clearance change, did the flightcrew (READ QUESTIONS)?

	YES	NO	RF	DK
A. Change a navigational aid frequency	1 (ASK 1)	0 (SKIP TO B)	7 (SKIP TO B)	8 (SKIP TO B)
1. Confirm the identity of the new navaid	1	0	7	8
B. Change the A.T.C. communication frequency	1	0	7	8
C. Revise the approach briefing	1	0	7	8
D. Change the airplane configuration	1	0	7	8
E. Disconnect any of the automated control systems?	1	0	7	8

IC15. Was the flight crew given a reason for the clearance change?

YES 1
NO .... (SKIP TO IC16) 0
RF .... (SKIP TO IC16) 7
DK .... (SKIP TO IC16) 8

A. Was one of the reasons given (READ QUESTIONS)?

	YES	NO	RF	DK
1. Wake turbulence avoidance	1	0	7	8
2. Maintaining traffic flow and separation	1	0	7	8
3. Providing a runway favorable to your gates	1	0	7	8
4. A change in active runways	1	0	7	8
5. Weather or wind factors	1	0	7	8
6. Noise abatement factors	1	0	7	8
7. A.T.C. equipment problems	1	0	7	8
8. Was any other reason given for the clearance change	1 ASK a	0	7	8

SKIP TO IC16

a. What reasons were given?

SPECIFY:____

IC16. Did responding to the clearance change (READ QUESTIONS)?

	YES	NO	RF	DK
A. reduce the quality of cockpit coordination	1	0	7	8
B. reduce situational awareness	1	0	7	8
C. Compromise traffic watch	1	0	7	8
D. Was safety compromised in any other way.	1 ASK 1.	0	7	8

NO, RF, DK: SKIP TO SECTION D.

1. How was safety compromised?

SPECIFY:______________________________

Air Carrier Questionnaire

Section C:
JIMDAT Questions

SECTION C: JIMDAT QUESTIONS

INTRODUCTION:

In the next section, I will be asking you some questions about your flying experience and training as it relates to terminal operations and instrument approaches. As we go forward, please limit you answers to those things that you personally experienced.

JD1.	Is the aircraft you flew (most) during the last 60 days equipped with G.P.W.S? GPWS = ground proximity warning system	NO ....(SKIP TO JD2) .... 0 YES .... 1 RF....(SKIP TO JD2) .... 7 DK ....(SKIP TO JD2) 8
	A. Is it equipped with a terrain display, such as you find in an enhanced G.P.W.S, or Terrain Avoidance Warning System, also known as TAWS (taws)?	NO ....(SKIP TO JD2) .... 0 YES .... 1 RF....(SKIP TO JD2) .... 7 DK ....(SKIP TO JD2) 8
	B. Does your airline require the terrain display to be selected during takeoff at specific airports?	NO OR NEVER ....(SKIP TO JD2) .... 0 YES OR SOMETIMES .... 1 RF....(SKIP TO JD2) .... 7 DK ....(SKIP TO JD2) 8
	C. Does your airline require the terrain display to be selected during descent and landing?	NO OR NEVER .... 0 YES OR SOMETIMES .... 1 RF.... 7 DK 8
	D. For times that terrain display is not required, do you usually use it during takeoff?	NO, NOT USUALLY .... 0 YES, USUALLY.... 1 RF.... 7 DK 8
	E. For times that terrain display is not required, do you usually use it during descent and landing?	NO, NOT USUALLY .... 0 YES, USUALLY.... 1 RF.... 7 DK 8
	F. Has the terrain display experienced a map shift on any aircraft on which you were a crew member?	NO OR NEVER .... 0 YES OR SOMETIMES .... 1 RF.... 7 DK 8
JD2.	During the last 60 days, how many times did an aircraft on which you were a crewmember experience a ground proximity warning?	# TIME ....|__|__|__| **IF ZERO, SKIP TO JD3**
	A. Was (this warning/ the most recent of these warnings) valid?	NO ....(SKIP TO JD3) .... 0 YES .... 1 RF....(SKIP TO JD3) .... 7 DK ....(SKIP TO JD3) 8
	B. During this (most recent) warning, did you see the approaching terrain on the terrain display before you heard the aural warning?	NO ....(SKIP TO JD3) .... 0 YES .... 1 RF....(SKIP TO JD3) .... 7 DK ....(SKIP TO JD3) 8

JD3. During the last 60 days, how many times did which you were a crewmember receive a Minimum Safe Altitude Warning Alert, also known as an MSAW (em-saw) or an altitude awareness call from an A.T.C controller?

TIME .... |__|__|__|

IF ZERO, SKIP TO JD4

A. (During the most recent of these events,) What did your aircraft do in response to the warning?

____

____

____

B. (During this most recent A.T.C. warning event,) Did the aircraft have an enhanced G.P.W.S. or T.A.W.S. (taws) installed?

NO .... (SKIP TO JD4) 0
YES 1
RF...................................... (SKIP TO JD4) 7
DK .... (SKIP TO JD4) 8

GPWS = GROUND PROXIMITY WARNING SYSTEM
TAWS = TERRAIN AVOIDANCE WARNING SYSTEM

1. Did your aircraft also receive a ground proximity warning from this system?

NO 0
YES 1
RF... 7
DK 8

JD4. How many times in the last 60 days, did an aircraft on which you were a crewmember fly a non-precision approach?

TIME .... |__|__|__|

IF ZERO, SKIP TO JD8

A. (Was this non-precision approach flown in I.M.C? / How many of these non-precision approaches were flown in I.M.C?)

TIME .... |__|__|__|

IMC = INSTRUMENT METEOROLOGICAL CONDITIONS

JD5. How many times in the last 60 days did an aircraft on which you were a crewmember fly an un-stabilized non-precision approach where the aircraft was not in landing configuration, on airspeed, or on glide-slope by 1,000 feet I.M.C or 500 feet V.M.C?

MC = METEOROLOGICAL CONDITIONS
VMC = VISUAL METEOROLOGICAL CONDITIONS

TIME .... |__|__|__|

IF ZERO, SKIP TO JD6

A. (During the most recent un-stabilized non precision approach,) What factors contributed to the inability to conduct a stabilized approach?

____

____

____

____

JD6. During the last 60 days, did an aircraft on which you were a crewmember have the choice between flying a constant angle approach or step-down non-precision approach?

NO .... (SKIP TO JD7) 0
YES 1
RF........ (SKIP TO JD7) 7
DK .... (SKIP TO JD7) 8

A. Which did you choose most often, the constant angle or step-down non-precision approach?

CONSTANT ANGLE 1
STEP-DOWN 2
CHOSE BOTH THE SAME 3
RF........ 7
DK 8

JD7. During the last 60 days, how many times did an aircraft on which you were a crewmember fly a non-precision approach to a runway when glide-slope information was available to you?

TIME .... |__|__|__|

IF ZERO, SKIP TO JD8

A. During (this/the most recent) non-precision approach, did you use the glide-slope information?

NO........ 0
YES 1
RF........ 7
DK 8

JD8. (Is the aircraft you fly/Are any of the aircraft you fly) LNAV/VNAV (L-nav/V-nav) capable?

LNAV = LATERAL NAVIGATION
VNAV = VERTICAL NAVIGATION

NO........ (SKIP TO JD9) 0
YES 1
RF........ (SKIP TO JD9) 7
DK .... (SKIP TO JD9) 8

A. Does your airline ever require pilots to use LNAV/VNAV (L-nav/V-nav) to fly constant angle approaches?

NO........ (SKIP TO JD9) 0
YES 1
RF........ (SKIP TO JD9) 7
DK .... (SKIP TO JD9) 8

1. In the last 60 days, how many times did an aircraft on which you were a crewmember use LNAV / VNAV (L-nav/V-nav) to fly constant angle approaches?

TIME .... |__|__|__|

B. During the last 60 days, how many times did an aircraft on which you were a crewmember not fly an LNAV/VNAV (L-nav/V-nav) approach when that option was available?

TIME .... |__|__|__|

IF ZERO, SKIP TO JD9

1. Please explain why the LNAV/VNAV (L-nav/V-nav) approach wasn't flown (during the most recent time that it was available).

____

____

____

JD9. During the last 60 days, was an aircraft on which you were a crewmember equipped to meet Required Navigation Performance standards, sometimes called R.N.P?

NO ....(SKIP TO JD10) 0
YES 1
RF......................................(SKIP TO JD10) 7
DK ....(SKIP TO JD10) 8

A. Does your airline choose to use R.N.P?

NO ....(SKIP TO JD10) 0
YES 1
RF......................................(SKIP TO JD10) 7
DK ....(SKIP TO JD10) 8

B. How many times in the last 60 days did an aircraft on which you were a crewmember fly an R.N.P approach?

TIME .... |__|__|__|

C. During the last 60 days, how many times did any aircraft on which you were a crewmember not fly an R.N.P approach when that option was available?

TIME .... |__|__|__|

IF ZERO, SKIP TO JD10

1. Please explain why the R.N.P. approach was not flown (most recent time that it was available).

____

____

____

JD10. **IF JD4 = 0, SKIP TO JD11.** During the last 60 days, how many times did an aircraft on which you were a crewmember fly a non-precision approach into an airport without D.M.E.?

TIME .... |_|_|_|

IF ZERO, SKIP TO JD11

DME = DISTANCE MEASURING EQUIPMENT

A. During (this event/the most recent of these events), would D.M.E have improved your ability to land safely?

NO 0
YES 1
RF 7
DK 8

JD11. During the last 60 days, how many times did an aircraft on which you were a crewmember fly an instrument approach into an airport where glide-slope or other ground based vertical angle guidance information was unavailable?

TIME .... |_|_|_|

IF ZERO, SKIP TO JD12

A. During (this approach/the most recent of these approaches), was D.M.E used to calculate the rate of descent for landing?

NO 0
YES 1
RF 7
DK 8

JD12. During the last 60 days, how many times did an aircraft on which you were a crewmember land on a runway without VASI (vasi) or PAPI (papi)?

TIME .... |_|_|_|

VASI = VERTICAL APPROACH SLOPE INDICATOR
PAPI = PRECISION APPROACH PATH INDICATOR

A. During the most recent of these events) would VASI (vasi) or PAPI (papi) have improved the aircraft's ability to land safely?

NO 0
YES 1
RF 7
DK 8

I would now like to ask you some questions about your airline's written standard operating procedures or SOPs.

JD13. Do your airline's written SOPs include Controlled Flight into Terrain prevention, sometimes called C-FIT (C-fit)?

NO 0
YES 1
RF 7
DK 8

JD14. Do your airline's written SOPs talk about how to avoid circumstances that could lead to an in-flight loss of control?

NO 0
YES 1
RF 7
DK 8

JD15. Do your airline's written SOPs talk about how to perform recovery from unusual **attitudes** and departure from controlled flight?

NO 0
YES 1
RF 7
DK 8

JD16. Do your airline's written SOPs talk about how to avoid approach and landing accidents?

NO 0
YES 1
RF 7
DK 8

JD17. Do your airline's written SOPs talk about how to fly non-precision approaches?

NO 0
YES 1
RF 7
DK 8

JD18. Do your airline's written SOPs require the use of constant angle non-precision approaches when that option is available?

NO 0
YES 1
RF 7
DK 8

JD19. Do your airline's written SOPs talk about how to respond to E.G.P.W.S warnings?

EGPWS = ENHANCED GROUND PROXIMITY WARNING SYSTEM

NO 0
YES 1
RF 7
DK 8

Now I would like to ask some questions about your recurrent training. By recurrent training I mean training conducted periodically that is designed to maintain your skills and knowledge. CLARIFICATION: This does not include transition or initial training. Recurrent training can include ground school, simulator training sessions, and any training conducted in the aircraft. I am going to read a list of issues. For each issue, please indicate if that topic or issue was covered during your last recurrent training.

JD20. In what month and year did you receive your most recent recurrent training?

MONTH .... |__|__|
YEAR .... |__|__|__|__|

JD21. Did your most recent recurrent training talk about basic airmanship?

NO 0
YES 1
RF 7
DK 8

A. Did your most recent recurrent training talk about normal approach procedures?

NO 0
YES 1
RF 7
DK 8

B. Did your most recent recurrent training talk about approach briefings?

NO 0
YES 1
RF 7
DK 8

C. Did your most recent recurrent training talk about criteria for initiating go-around and missed approaches?

NO 0
YES 1
RF 7
DK 8

D. Did your most recent recurrent training talk about go-around and missed approach execution?

NO 0
YES 1
RF 7
DK 8

E. Did your most recent recurrent training talk about emergency or abnormal conditions procedures?

NO 0
YES 1
RF 7
DK 8

Now I would like to ask you some questions concerning training you may have received addressing controlled flight into terrain, or C-FIT (C-fit), and other issues

JD22. Have you received C-FIT (C-fit) prevention training from your airline?

NO ....(SKIP TO JD23) 0
YES 1
RF....................(SKIP TO JD23) 7
DK ....(SKIP TO JD23) 8

A. In what month and year did you receive your most recent C-FIT (C-fit) prevention training?

MONTH .... |__|__|
YEAR.. |__|__|__|__|

B. Did your most recent C-FIT (C-fit) prevention training talk about minimum obstruction clearance altitudes or MOCA (mo ca)?

NO 0
YES 1
RF.. 7
DK 8

C. Did your most recent C-FIT (C-fit) prevention training talk about minimum enroute altitudes or M.E.A?

NO 0
YES 1
RF.. 7
DK 8

D. Did your most recent C-FIT (C-fit) prevention training talk about grid

MORA = MINIMUM OPERATING RADAR ALTITUDE

NO 0
YES 1
RF.. 7
DK 8

E. Did your most recent C-FIT (C-fit prevention training talk about G.P.W.S or E.G.P.W.S?

GPWS = GROUND PROXIMITY WARNING SYSTEM
EGPWS = ENHANCED GROUND PROXIMITY WARNING SYSTEM

NO 0
YES 1
RF.. 7
DK 8

F. Did your most recent C-FIT (C-fit) prevention training talk about escape maneuvers in response to G.P.W.S or G.P.W.S warnings?

GPWS = GROUND PROXIMITY WARNING SYSTEM
EGPWS = ENHANCED GROUND PROXIMITY WARNING SYSTEM

NO 0
YES 1
RF.. 7
DK 8

G. Did your most recent C-FIT (C-fit) prevention training talk about drift down procedures after engine failure?

NO 0
YES 1
RF.. 7
DK 8

H. Did your most recent C-FIT (C-fit) prevention training talk about maintaining situational awareness?

NO 0
YES 1
RF.. 7
DK 8

	I. Did your most recent C-FIT (C-fit) prevention training talk about cockpit resource management, or C.R.M as it relates to C-FIT (C-fit) recovery? NOTE: CRM CAN ALSO = <u>CREW</u> RESOURCE MANAGEMENT	NO .... 0 YES .... 1 RF .... 7 DK 8
	J. How would you rate the quality of the most recent C-FIT (C-fit) prevention training you received from your airline? Would you say it was (READ CATEGORIES)?	EXCELLENT .... 1 GOOD .... 2 FAIR .... 3 POOR .... 4 VERY POOR 5
JD23.	Did you receive training specifically in upset recovery from your airline?	NO .... (SKIP TO JD24) .... 0 YES .... 1 RF .... (SKIP TO JD24) .... 7 DK .... (SKIP TO JD24) 8
	A. In what month and year did you receive your most recent training in upset recovery?	MONTH .... |__|__| YEAR .... |__|__|__|__|
	B. Was this training received in a simulator, in a ground school, or both?	SIMULATOR .... 1 GROUND SCHOOL .... 2 BOTH .... 3 RF .... 7 DK 8
	C. How would you rate the quality of the upset recovery training you received? Would you say it was (READ CATEGORIES)?	EXCELLENT .... 1 GOOD .... 2 FAIR .... 3 POOR .... 4 VERY POOR 5
JD24.	Does your airline provide training in Cockpit or Crew Resource Management, sometimes called C.R.M?	NO .... (SKIP TO JD25) .... 0 YES .... 1 RF .... (SKIP TO JD25) .... 7 DK .... (SKIP TO JD25) 8
	A. Have you received this C.R.M training?	NO .... (SKIP TO JD25) .... 0 YES .... 1 RF .... (SKIP TO JD25) .... 7 DK .... (SKIP TO JD25) 8
	B. Did this C.R.M. training change how you manage the flight deck?	NO .... 0 YES .... 1 RF .... 7 DK 8
	C. Do you have suggestions for how the C.R.M training might be improved?	NO .... 0 YES .... 1 RF .... 7 DK 8
	D. What suggestions do you have?	

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____

____

JD25. Does your airline have a no-fault missed approach or go-around policy?

CLARIFICATION: No fault means that the airline does not apply disciplinary action or criticize pilots who exercise their authority to exercise a missed approach or go around.

NO ....(SKIP TO JD26) 0
YES 1
RF......................................(SKIP TO JD26) 7
DK ....(SKIP TO JD26) 8

A. Would you favor the institution of such policy, oppose it, or neither favor nor oppose it?

FAVOR 1
OPPOSE 2
NEITHER FAVOR NOR OPPOSE 3
RF.. 7
DK 8

JD26. During the last 60 days did you perform a missed approach or go around?

NO ....(SKIP TO JD27) 0
YES 1
RF......................................(SKIP TO JD27) 7
DK ....(SKIP TO JD27) 8

A. Did you receive any feedback from your airline regarding this missed approach

NO ....(SKIP TO JD27) 0
YES 1
RF......................................(SKIP TO JD27) 7
DK ....(SKIP TO JD27) 8

B. Was that feedback positive, negative, or both positive and negative?

POSITIVE 1
NEGATIVE 2
BOTH POSITIVE AND NEGATIVE 3
RF.. 7
DK 8

JD27. Does your airline participate in the safety reporting program called A-SAP (A-sap) also known as the Aviation Safety Action Program?

NO ....(SKIP TO JD28) 0
YES 1
RF......................................(SKIP TO JD28) 7
DK ....(SKIP TO JD28) 8

A. Have you been briefed on this A-SAP (A-sap) program?

NO 0
YES 1
RF.. 7
DK 8

B. Were you told about the general purpose of the A-SAP (A-sap) program?

NO 0
YES 1
RF.. 7
DK 8

C. Were you told how to submit an A-SA A-sap) report?

NO 0
YES 1
RF.. 7
DK 8

D. If the situation arises in the future, would you submit an A-SAP (A-sap) report?

NO 0
YES ....(SKIP TO JD27E)..................... 1
RF......................................(SKIP TO JD27E)..................... 7
DK ....(SKIP TO JD27E) 8

1. Why not?

____

____

____

____

E. Do you believe that the confidentiality of A-SAP (A-sap) data is adequately protected?

NO		0
YES	(SKIP TO JD27E)	1
RF	(SKIP TO JD27E)	7
DK	(SKIP TO JD27E)	8

CLARIFICATION: Confidentiality refers to both the reporter and to the use of the data.

1. Why not?

____

____

____

____

F. Are you aware of any positive changes program other than A-SAP (A-sap) for receiving safety reports from pilots?

NO		0
YES		1
RF		7
DK		8

IF ZERO, SKIP TO JD29

JD28. Does your airline have a procedure or program other than A-SAP (A-sap) for receiving safety reports from pilots?

NO	(SKIP TO JD29)	0
YES		1
RF	(SKIP TO JD29)	7
DK	(SKIP TO JD29)	8

A. Are you aware of any positive changes that have resulted from this pilot reporting program?

NO		0
YES		1
RF		7
DK		8

B. Would you favor the establishment of an A-SAP (A-sap) program, oppose it, or neither favor nor oppose it?

FAVOR		1
OPPOSE		2
NEITHER FAVOR NOR OPPOSE		3
RF		7
DK		8

JD29. Does your airline have a Flight Operations Quality Assurance Program, sometimes called FOQA (FO Qua)?

NO	(ASK JD29A)	0
YES	(SKIP TO JD29B)	1
RF	(SKIP TO JD30)	7
DK	(SKIP TO JD30)	8

CLARIFICATION: This is a program at some airlines that analyzes operational data routinely collected from the flight data recorders with concurrence and oversight by the pilot's union or association at that airline.

A. Would you favor the establishment of a FOQA (FO Qua) program at your airline, oppose it, or neither favor nor oppose?

FAVOR		1
OPPOSE		2
NEITHER FAVOR NOR OPPOSE		3
RF		7
DK		8

IF ZERO, SKIP TO JD30

B. Have you been briefed on the program?

NO 0
YES 1
RF 7
DK 8

C. Do you believe that the confidentiality of FOQA (FO Qua) data is adequately protected?

CLARIFICATION: Confidentiality refers to both the identity of the pilot flying the aircraft and to the use of the data.

NO 0
YES 1
RF 7
DK 8

D. Are you aware of any safety improvements that have resulted from the FOQA (FO Qua) program?

NO 0
YES 1
RF 7
DK 8

We are interested in hearing about the safety culture at your airline, as expressed by your senior management. By senior management, we mean the C.E.O., Director of Safety, V.P. for Safety, Director of Flight Operations, and other senior management.

CEO = CHIEF EXECUTIVE OFFICER
VP = VICE PRESIDENT

JD30. Does your airline have a C.E.O. mission statement on safety?
CEO = CHIEF EXECUTIVE OFFICER

NO 0
YES 1
RF 7
DK 8

JD31. Does your airline have a Director of Safety?

NO 0
YES 1
RF 7
DK 8

JD32. Does your airline have a V.P. of Safety?
VP = VICE PRESIDENT

NO 0
YES 1
RF 7
DK 8

JD33. Have you observed a strong commitment to safety among senior management? (This question focuses on behavior.)

NO .... (SKIP TO JD34) 0
YES 1
RF .... (SKIP TO JD34) 7
DK .... (SKIP TO JD34) 8

A. Is this senior management commitment to safety reflected throughout the organization?

NO 0
YES 1
RF 7
DK 8

JD34. If you have a safety concern, do you have a mechanism for bringing that concern to the attention of senior management?

NO .... (SKIP TO SECTION D) 0
YES 1
RF .... (SKIP TO SECTION D) 7
DK .... (SKIP TO SECTION D) 8

A. How effective is this mechanism in reaching senior management? Would you say (READ CATEGORIES)?

EXTREMELY EFFECTIVE 1
VERY EFFECTIVE 2
SOMEWHAT EFFECTIVE 3
NOT VERY EFFECTIVE 4
NOT AT ALL EFFECTIVE 5

Air Carrier Questionnaire

Section D:
Questionnaire Feedback

SECTION D: QUESTIONNAIRE FEEDBACK

INTRODUCTION:

I only have a couple more questions and these are about your reactions to the survey we have just done.

D1. How confident are you that you accurately counted all of the safety-related events that I asked you about? Would you say you were (READ QUESTIONS)?

Not confident at all 1
Slightly confident 2
Moderately confident 3
Very confident 4
Extremely confident 5
RF 7
DK 8

D2. Were any of the questions I asked confusing, poorly worded, or ambiguous?

YES 1
NO .... (SKIP TO D3) 0
RF .... (SKIP TO D3) 7
DK` .... (SKIP TO D3) 8

A. Could you please describe these question problems? RECORD VERBATIM. AT COMPLETION OF INTERVIEW, ENTER QUESTION NUMBER.

QUESTION NUMBER	RECORD VERBATIM

D3. Are there any safety problems happening within the national aviation system that I did not ask about but that you think may be worth asking about in further surveys?

YES 1
NO .... (SKIP TO D4) 0
RF .... (SKIP TO D4) 7
DK` .... (SKIP TO D4) 8

A. What are these problems?

SPECIFY: ____________________

D4. Do **you** use the internet at home?

YES 1
NO 0
RF 7
DK 8

D5. Do you have any other comments or suggestions about this survey? RECORD VERBATIM.

____

____

____

____

PANEL PASSWORD HINT	TAKES INTERVIEWER TO "NEEDPAS" (PANEL 1ST QTR OR LATER QTR BUT NEVER COMPLETED INTERVIEW) OR PAST PATH (PANEL 2ND QTR OR LATER WHO PREVIOUSLY GAVE PASSWORD).
NEEDPASS: We would like to be able to link the information you give us each time we call. Because we do not link your information with your name, we would like to record an individual password we can use to link your data. May we please have a password that you will repeat to us when we call you again?	AGREED ..... 1 REFUSED ..... (ENDINT) 7
PICKPASS: RECORD PASSWORD	TAKES INTERVIEWER TO ENDINT.
ASKFORHINT: Please give us a question that we can use as a hint in case you are unable to remember your password the next time we call. For instance, if you choose the word "RED" as your password, your hint question could be "What is my favorite color?"	RECORD HINT
PASTPATH: At the end of your last interview you gave us a password so we could link your information across quarters. Your hint question was (HINTQUESTION). What was your password? RECORD.	REMEMBERS PASSWORD ..... (REPREATPASS) ..... 1 REFUSED ..... (ENDINT) ..... 7 CAN'T REMEMBER ..... (SUBSPASS) 8
REPEATPASS: RECORD PASSWORD.	IF SUCCESSFUL, TAKES INTERVIEWER TO ENDINT.
IF PASSWORD NOT IN PASSWORD LIST: The word you gave me does not match our list of passwords. Perhaps I spelled it wrong. How do you spell your password? RETURN TO REPEATPASS FIELD AND RECORD PASSWORD AGAIN. IF WORD STILL DOESN'T MATCH AFTER TWO ATTEMPTS, CLICK, SUPPRESS.	IF SUPPRESSED, TAKES INTERVIEWER TO SUBSPASS.

SUBSPASS: Since (you can't remember/we don't seem to have) your previous password, we'd like you to choose another password and hint so we can link your future interviews. May we please have another password and hint that you will repeat to us when we call again?

YES .... (PICKPASS) 1
NO .... (ENDINT) 0

ENDINT Again, thank you very much for your time and your help with this survey. Your input will help the aviation industry a great deal to measure the level of safety in the aviation system and will be held in confidence.
IF PANEL MEMBER: We'll be calling again in three months for your (2nd/3rd/last) interview.

QUESTIONNAIRE LENGTH:

QUESTIONNAIRE LENGTH (MINUTES) .... |__|__|__|

Appendix 12: General Aviation Questionnaire

NAOMS began interviewing general aviation (GA) pilots on August 7th, 2002. The approach used for GA pilot interviews was quite similar to that used for air carrier (AC) pilots. The questionnaire consisted of four sections that corresponded with the general topics covered in the air carrier questionnaire: Section A addressed pilot qualifications and experience; Section B addressed safety events; Section C addressed a specific focus topic (weather-related issues); and Section D offered pilots an opportunity to provide feedback on the interview process and the questionnaire. This appendix contains a copy of the GA questionnaire.

Source: Battelle Centers for Public Health Research and Evaluation (CPHRE).

Appendix 12: General Aviation Questionnaire

INTRODUCTION:	Hello, I'm (NAME) calling for NASA. We sent you a letter a few days ago to tell you about the National Aviation Operations Monitoring Service project that NASA is conducting.

SQ1. Did you receive the letter?

NO ....(READ SCRIPT).................................... 0
YES ....(SKIP TO SQ2)..................................... 1

SCRIPT:	I'm sorry. Let me read to you what it says. The purpose of this project is to provide reliable safety data for improving aviation safety. We randomly selected pilots from the pilot registry to participate in this interview. The interview will only take about 30 minutes. The anonymous information you provide will be combined with information submitted by about 10,000 other general aviation pilots. Your participation is entirely voluntary. The information you provide will be held in complete confidence. NASA **will not** retain any record of your identity, or link your name to your answers in any way.

SQ2. Before beginning, first let me check your recent flight experience against our survey requirements. Have you flown as a pilot or co-pilot logging hours on an airplane or in a helicopter during the last 60 days? Please do not include non-powered aircraft, military or ultra-light flying. (Note to interviewers: "co-pilot logging hours means that you flew as a co-pilot and logged hours in your official FAA logbook.")

NO ....(SKIP TO TERMINATION SCRIPT)...................... 0
YES 1

TERMINATION SCRIPT: I'm sorry, but we are only interviewing pilots who have flown in the last 60 days. NASA would like to thank you for your time. Goodbye. **TERMINATE INTERVIEW**

SQ3. The interview may be monitored by my supervisor for quality control purposes. Is this a good time to proceed?

NO .... (FILL OUT CALL BACK INFORMATION) 0
YES .... (PROCEED TO A1) 1

TIME BEGUN .... (MILITARY)................. |__|__| : |__|__|
(FILLS)

INTERVIEWER: DATE OF INTERVIEW IS BEING RECORDED AS (START DATE).
IS THIS THE CORRECT DATE:

NO.................(RECORD DATE OF INTERVIEW)................0
YES...1

START DATE ....|__|__| / |__|__| / |__|__|
MONTH DAY YEAR

.... **START DATE = 60 DAYS BEFORE END DATE**

END DATE..|__|__| / |__|__| / |__|__|
(FILLS) MONTH DAY YEAR

END DATE = DAY BEFORE DAY OF INTERVIEW

General Aviation Questionnaire

Section A:
Background Questions

SECTION A: BACKGROUND QUESTIONS

INTRODUCTION: The first few questions are about your general flying experience.

A1	Do you hold an A.T.P certificate or instrument rating? ATP=AIRLINE TRANSPORT PILOT	NO .... 0 YES .... 1 RF .... 7 DK 8
	A. Are you I.F.R current? NOTE: IFR = Instrument Flight Rules	NO .... 0 YES .... 1 RF .... 7 DK 8
A2	During your **life,** approximately how many **hours in total** have you flown as a pilot? Include all types of flying including FAR part 121 air carrier, military service, and ultralight flying.	TOTAL HOURS DURING LIFE .... ___ , ___ RF .... 99 997 DK 99 998

INTRODUCTION: The rest of the questions will refer to 60 days prior to today. Whenever I say the "last 60 days," I am referring to the period from (START DATE) through (END DATE). Also, for all these questions, I will be asking you about events when you flew as a pilot in command or copilot logging hours in your official FAA logbook under FAR Part 121, Part 135 or Part 91. First I would like to ask a few questions about the type of flying you have done in the last 60 days.

A3.	During the last 60 days, how many **hours** did you fly as a pilot or copilot under FAR Part 121, Part 135, or Part 91?	TOTAL HOURS FLOWN LAST 60 DAYS .... ___ NO HOURS(TERMINATE INTERVIEW, CODE "NOT ELIGIBLE" IIF HOURS IN A3 ARE ABOVE 300 ASK A. OTHER RESPONSES SKIP TO A4
	A. I'd just like to verify. You said you flew (# HOURS A3) **hours** during the last 60 days. Is this correct?	NO (ASK B) .... 0 YES .... (SKIP TO A4) .... 1 RF .... (SKIP TO A4) .... 7 DK .... (SKIP TO A4) 8
	B. During the last 60 days, how many **hours** did you fly? NOTE TO INTERVIEWER: AS A PILOT OR COPILOT UNDER FAR PART 121, PART 135 OR PART 91.	# HOURS .... ___ RF .... 997 DK 998
A4	How many of these (HOURS IN A3) hours did you fly as an airplane pilot or copilot **under FAR Part 121**?	# OF HOURS FAR PART 121 .... ___ RF .... 997 DK .... 998 **HOURS CANNOT EXCEED HOURS IN A3.**
A5	How many of these (HOURS IN A3) hours did you fly as an pilot or copilot **under FAR Part 135?**	# HOURS UNDER FAR 135 .... ___ RF .... 997 DK .... 998 **HOURS CANNOT EXCEED HOURS IN A3 MINUS A4.** **IF >0, ASK A. OTHERS SKIP TO A6.**
	A. Of the (HOUR IN A5) hours flown under Part 135, how many were flown on fixed wing airplanes?	# HOURS FAR 135 AIRPLANE .... ___ RF .... 997 DK .... 998 **HOURS CANNOT EXCEED HOURS IN A5.** **IF = A5, SKIP TO A6.** **IF <A5, ASK A5B.**

B. Of the (HOUR IN A5) hours flown under Part 135, how many were flown on helicopters?

HOURS FAR 135 HELICOPTER .... |__|__|__|
RF..997
DK..998
HOURS CANNOT EXCEED HOURS IN A5 MINUS A5A.

A6 How many of these (HOURS IN A3) hours did you fly as a pilot or copilot **under FAR Part 91?**

HOURS UNDER FAR 91.. |__|__|__|
RF..997
DK..998
HOURS CANNOT EXCEED HOURS IN A3 MINUS SUM (A4 PLUS A5).
IF >0, ASK A. OTHERS SKIP TO A6.

A. Of the (HOUR IN A65) hours flown under Part 91, how many were flown on fixed wing airplanes?

HOURS FAR 91 AIRPLANE.................................... |__|__|__|
RF..997
DK..998
HOURS CANNOT EXCEED HOURS IN A6.
IF = A6, SKIP TO A7.
IF <A6, ASK A6B.

B. Of the (HOUR IN A5) hours flown under Part 91, how many were flown on helicopters?

HOURS FAR 91 HELICOPTER .... |__|__|__|
RF..997
DK..998
HOURS CANNOT EXCEED HOURS IN A6 MINUS A6A.

INTRODUCTION: Now I'd like to ask a few questions about the number of takeoffs or flights you made during the last 60 days. We use the terms "flight" throughout this interview to mean the period of time between each takeoff and landing, even if that time is short such as for instructors teaching students to land. READ A7-A11 WHEN APPLICABLE.

A7 IF A4 > 0, READ: During the last 60 days you mentioned you flew (# HOUR A4) hours as an **airplane pilot or copilot under FAR Part 121.** How many flights or legs did you experience as a pilot or copilot during this period?

OF LEGS/TAKEOFFS PART 121 .... |__|__|__|
RF..997
DK..998

A8 IF A5A > 0, READ: During the last 60 days you mentioned you flew (# HOUR A5A) hours as an **airplane** pilot or copilot **under FAR Part 135.** How many **takeoffs** did you experience as an airplane pilot or copilot during this period?

PART 135 AIRPLANE TAKEOFFS .... |__|__|__|
RF..997
DK..998

IF A8 BLANK OR 0, SKIP TO A9.

A. Of these (# TAKEOFFS A8) flights, how many occurred during night time conditions?

PART 135 AIRPLANE FLIGHTS NIGHT.................. |__|__|__|
RF..997
DK..998

MUST BE EQUAL TO OR LESS THAN A8

B. Of these (# TAKEOFFS A8) flights, how many were at least 50 nautical miles long?

PART 135 AIRPLANE FLIGHTS LONG................... |__|__|__|
RF..997
DK..998

MUST BE EQUAL TO OR LESS THAN A8

A9 IF A5B > 0, READ: During the last 60 days you mentioned you flew (# HOUR A5A) hours as **a helicopter** pilot or copilot **under FAR Part 135.** How many **takeoffs** did you experience as a helicopter pilot or copilot during this period?

PART 135 HELICOPTER TAKEOFFS .... |__|__|__|
RF..997
DK..998

IF A9 BLANK OR 0, SKIP TO A10.

	A. Of these (# TAKEOFFS A9) flights, how many occurred during night time conditions?	# PART 135 HELICOPTER FLIGHTS NIGHT............. ⌊_⌊_⌊_⌋ RF...997 DK..998 **MUST BE EQUAL TO OR LESS THAN A9**
	B. Of these (# TAKEOFFS A9) flights, how many were at least 50 nautical miles long?	# PART 135 HELICOPTER FLIGHTS LONG.............. ⌊_⌊_⌊_⌋ RF...997 DK..998 **MUST BE EQUAL TO OR LESS THAN A9**
A10	D. IF A6A > 0, READ: During the last 60 days you mentioned you flew (# HOUR A5A) hours as **an airplane** pilot or copilot **under FAR Part 91.** How many **takeoffs** did you experience as an airplane pilot or copilot during this period?	# OF TAKEOFFS PART 91 AIRPLANE .... ⌊_⌊_⌊_⌋ RF...997 DK..998 **IF A10 BLANK OR 0, SKIP TO A11.**
	A. Of these (# TAKEOFFS A10) flights, how many occurred during night time conditions?	# PART 91 AIRPLANE FLIGHTS NIGHT.................... ⌊_⌊_⌊_⌋ RF...997 DK..998 **MUST BE EQUAL TO OR LESS THAN A10**
	B. Of these (# TAKEOFFS A9) flights, how many were at least 50 nautical miles long?	# PART 135 AIRPLANE FLIGHTS LONG................... ⌊_⌊_⌊_⌋ RF...997 DK..998 **MUST BE EQUAL TO OR LESS THAN A10**
A11	IF A6B > 0, READ: During the last 60 days you mentioned you flew (# HOUR A5A) hours as a **helicopter** pilot or copilot **under FAR Part 91.** How many **takeoffs** did you experience as a helicopter pilot or copilot during this period?	# OF TAKEOFFS PART 91 HELICOPTER .... ⌊_⌊_⌊_⌋ RF...997 DK..998 **IF A11 BLANK OR 0, SKIP TO A12.**
	A. Of these (# TAKEOFFS A10) flights, how many occurred during night time conditions?	# PART 91 HELICOPTER FLIGHTS NIGHT............... ⌊_⌊_⌊_⌋ RF...997 DK..998 **MUST BE EQUAL TO OR LESS THAN A11**
	B. Of these (# TAKEOFFS A9) flights, how many were at least 50 nautical miles long?	# PART 135 HELICOPTER FLIGHTS LONG.............. ⌊_⌊_⌊_⌋ RF...997 DK..998 **MUST BE EQUAL TO OR LESS THAN A11**
A12	ASK ONLY IF A1 = YES. During the last 60 days, for how many flights did you file an I.F.R flight plan?	# FILED IFR FLIGHT PLAN .... ⌊_⌊_⌊_⌋ RF...997 DK ....998 **FLIGHTS CANNOT EXCEED SUM OF (A8+A9+A10+A11)**

INSTRUCTION:
REVIEW A1, A2 AND A3, THEN FOLLOW THE *FIRST* INSTRUCTION THAT APPLIES.

- **IF A1 HIGHEST, FOLLOW AIRPLANE ROUTE.**
- **IF A2 HIGHEST, FOLLOW AIR CARRIER ROUTE.**
- **IF A3 HIGHEST, FOLLOW HELICOPTER ROUTE.**
- **IF ANY TWO OR THREE ARE EQUAL, FOLLOW ROUTES IN FOLLOWING PRIORITY:**
  - 0 **HELICOPTER**
  - 0 **AIRPLANE**
  - 0 **AIR CARRIER**
- ***OR ANY OTHER ORDER WE WOULD PREFER!***

INTRODUCTION:
You mentioned that during the last 60 days you flew (# HOURS DECIDED FROM ABOVE) hours flying as (an airplane/a helicopter) pilot or copilot under FAR (Part 135/Part 91/Part 135 and Part 91). For the rest of the interview, I will be asking you about your experiences flying (airplanes/helicopters) during this period of time.

A13. AIRPLANES AND HELICOPTERS During the last 60 days, did you fly an airplane engaged in FAR Part 135 or Part 91 air carrier operations in any of the following capacities (READ CATEGORIES)?

	YES	NO	RF	DK
a. as a captain or pilot in command..........................	1	0	7	8
b. as a copilot or first officer	1	0	7	8
c. as an instructor pilot	1	0	7	8
d. in any other capacity	1 (ASK 1)	0	7	8

1. What was that capacity? SPECIFY

SPECIFY:_______________________________________

A14. I am now going to read a list of different types of general aviation flying. Please tell me if you engaged in any of these types of flying during the last 60 days. Did you undertake any (airplane/helicopter) flights (READ CATEGORIES)?

	NO	YES ***(ASK COL I.)***	RF	DK	***COL I.*** Approximately how many hours would you say was devoted to (BOLD WORDS IN A9a-g)?
a. for **flight instruction as the instructor** .... (NOTE: INCLUDES CHECKOUT FLIGHTS)	0	1	7	8	|_|_|_|
b. for **flight instruction as the student**..... (NOTE: INCLUDES CHECKOUT FLIGHTS)	0	1	7	8	|_|_|_|
c. for **corporate transportation** as a pilot employee of a corporate flight department.. (NOTE: DOES NOT INCLUDE CHARTER FLIGHTS)	0	1	7	8	|_|_|_|
d. for you to **support your own business**..	0	1	7	8	|_|_|_|

e.	in **aircraft owned or operated by government entities**, sometimes called public use flights	0	1	7	8	|__|__|__|
f.	**flights with revenue passengers**? (NOTE: THIS MEANS PAYING PASSENGERS WHO ARE ON THE AIRCRAFT)	0	1	7	8	|__|__|__|
g.	**flights that carried only cargo or freight and did not carry revenue passengers**?	0	1	7	8	|__|__|__|
f.	for **transporting patients or critical medical products** such as organs for transplant or blood	0	1	7	8	|__|__|__|
g.	for **recreation or personal transportation** not associated with business	0	1	7	8	|__|__|__|
h.	for any other purpose (SPECIFY)	0	1	7	8	|__|__|__|

SPECIFY VERBATIM: ____

A15. Please tell me all of the (airplane/helicopter) makes and models you flew as a pilot or copilot during the last 60 days. RECORD VERBATIM. **LIST ALL MODELS THEN ASK COL I. AND II. FOR EACH.**

MAKE/MODEL (RECORD VERBATIM)	***COL I.*** During the last 60 days, how many hours you fly the (MAKE/MODEL)?	***COL II.*** How many engines does this aircraft have?	**COL III** Is this an experimental airplane?
1st ______________________	|__|__|__|	|__|__|__|	YES NO RF DK
2nd ______________________	|__|__|__|	|__|__|__|	YES NO RF DK
3rd ______________________	|__|__|__|	|__|__|__|	YES NO RF DK
4th ______________________	|__|__|__|	|__|__|__|	YES NO RF DK
5th ______________________	|__|__|__|	|__|__|__|	YES NO RF DK
6th ______________________	|__|__|__|	|__|__|__|	YES NO RF DK

A16 (AIRPLANE ONLY) During the last 60 days, how many hours did you fly an experimental airplane?

HOURS FLY EXPERIMENTAL...............
RF……….(SKIP TO a14)…………997
DK……….(SKIP TO A14)…………998

A. What was the make and model of the experimental airplane?

RECORD MAKE/MODEL

General Aviation Questionnaire

Section B:
Safety Related Events

SECTION B: SAFETY RELATED EVENTS

INTRODUCTION:

My next set of questions are about safety related events. Just as a reminder, I'd like you to report only events that **you experienced flying under FAR Part 135 or Part 91 on (an airplane/a helicopter) on which you were a** pilot or copilot. The first questions are about **equipment-related events.**

ER1. How many times during the last 60 days did (an airplane/a helicopter) on which you were a pilot or copilot divert to an alternate airport or return to land because of (an airplane/ a helicopter) equipment problem?

EQUIPMENT PROBLEMS ....|__|__|__|

IF 0, SHIP TO ER2.

A. ASK ONLY IF MORE THAN ONE MAKE/ MODEL IN A10. Which (airplane/helicopter) experienced this equipment problem? Was it (READ A10 MAKE/MODEL LIST).

RECORD MAKE/MODEL

B. What systems caused the diversion or return to land?

SPECIFY:

ER2-A AIRPLANES ONLY

I am going to read a list of possible airplane malfunctions or failures. For each one, please tell me how many times during the last 60 days an **in-flight airplane** on which you were a pilot or copilot experienced any of these malfunctions or failures. If a piece of equipment does not apply, please answer "not applicable" rather than "zero". How many times did you experience (READ QUESTIONS):

A. Uncommanded movements of the speedbrakes?

SPEEDBRAKERS ....|__|__|__|

IF 0, SKIP TO B.

1. ASK ONLY IF MORE THAN ONE MAKE/ MODEL IN A10.

Which aircraft experienced this malfunction? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

B. Uncommanded movements of the trim tabs?

TRIM TABS...|__|__|__|

IF 0, SKIP TO C.

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which aircraft experienced this malfunction? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

C. Uncommanded movements of the flaps?

FLAPS .... |__|__|__|

IF 0, SKIP TO D.

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which aircraft experienced this malfunction? Was it (READ A10 MAKE/MODEL LIST

SPECIFY MAKE/MODEL:

D. Failure of the trim system to operate?

TRIM .... |__|__|__|

IF 0, SKIP TO E.

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which aircraft experienced this failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

E. Failure of the landing gear to extend or retract?

GEAR .... |__|__|__|

IF 0, SKIP TO F.

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which aircraft experienced this failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

F. Failure of the flaps to extend or retract?

FLAPS IN OR OUT .... |__|__|__|

IF 0, SKIP TO G.

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which aircraft experienced this failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

G. Did you experience a malfunction or failure of any other aircraft device or system during the last 60 days?

YES		1
NO	(SKIP TO ER3)	0
RF	(SKIP TO ER3)	7
DK	(SKIP TO ER3)	8
NA	(SKIP TO ER3)	9

Which aircraft experienced this malfunction or failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

Which device or system malfunctioned or failed?

SPECIFY: ______________________________

ER2-H HELICOPTER ONLY.
I am going to read a list of possible helicopter malfunctions or failures. For each one, please tell me how many times during the last 60 days an **in-flight helicopter** on which you were a pilot or copilot experienced any of these malfunctions or failures. If a piece of equipment does not apply, please answer "not applicable" rather than "zero". How many times did you experience (READ QUESTIONS):

A. Uncommanded movements of the trim?

UNCOMMANDED TRIM .... |__|__|__|

IF 0, SKIP TO B.

1. ASK ONLY IF MORE THAN ONE MAKE/ MODEL IN A10.

   Which helicopter experienced this malfunction? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

B. Failure of the trim system to operate?

FAILURE TRIM .... |__|__|__|

IF 0, SKIP TO C.

1. ASK ONLY IF MORE THAN ONE MAKE/ MODEL IN A10.

Which helicopter experienced this failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

C. Failure of the landing gear to extend or retract?

FAILURE GEAR .... |__|__|__|

IF 0, SKIP TO D.

N/a

1. ASK ONLY IF MORE THAN ONE MAKE/ MODEL IN A10.

Which helicopter experienced this failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

D. Tail rotor failure?

FAILURE TAIL ROTOR .... |__|__|__|

IF 0, SKIP TO E.

1. ASK ONLY IF MORE THAN ONE MAKE/ MODEL IN A10.

Which helicopter experienced this failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

E. Failure of hydraulic system?

FAILURE HYDRAULIC SYSTEM .... |__|__|__|
IF 0, SKIP TO F.

1. ASK ONLY IF MORE THAN ONE MAKE/ MODEL IN A10.

Which helicopter experienced this failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

F. Valid transmission warning of potential failure?

TRANSMISSION WARNING .... |__|__|__|
IF 0, SKIP TO G.

1. ASK ONLY IF MORE THAN ONE MAKE/ MODEL IN A10.

Which helicopter experienced this warning? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

G. Did you experience a malfunction or failure of any other aircraft device or system during the last 60 days?

YES..1
NO .... (SKIP TO ER3)...................................0
RF .... (SKIP TO ER3)...................................7
DK .... (SKIP TO ER3)...................................8

1. ASK ONLY IF MORE THAN ONE MAKE/ MODEL IN A10.

Which helicopter experienced this malfunction or failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

1) Which device or system malfunctioned or failed? ______________________________

ER3. How many times during the last 60 days did an inflight (airplane/helicopter) on which you were a pilot or copilot experience smoke, fire, or fumes that originated in any of the following areas (READ QUESTIONS):

A. the engine, engine compartment or nacelle?

IN ENGINE OR NACELLE .... |__|__|__|

IF 0, SKIP TO ER3B.

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

   Which (airplane/helicopter) experienced smoke, fire or fumes in the engine or nacelle? Was it (READ A10 MAKE/MODEL LIST)?

   SPECIFY MAKE/MODEL:

2. (Of the [# in ER3A] times there was smoke, fire, or fumes in the engine or nacelle, how many involved/Did the smoke, fire, or fumes in the engine or nacelle involve) electrical components or wiring?

   # NACELLE SMOKE/FIRE/FUMES .... |__|__|__|

   THE AMOUNT IN ER3A1 CANNOT BE GREATER THAN THE AMOUNT IN ER3A.

B. the cockpit?

IN COCKPIT.. |__|__|__|

IF 0, SKIP TO ER3C

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

   Which (airplane/helicopter) experienced smoke, fire or fumes in the cockpit? Was it (READ A10 MAKE/MODEL LIST)?

   SPECIFY MAKE/MODEL:
   .

2. (Of the [# in ER3B] times there was smoke, fire, or fumes in the cockpit, how many involved/Did the smoke, fire, or fumes in the cockpit deck involve) electrical components or wiring?

   COCKPIT SMOKE/FIRE/FUMES .... |__|__|__|

   THE AMOUNT IN ER3B1 CANNOT BE GREATER THAN THE AMOUNT IN ER3B.

C. the cargo or baggage area?

IN CARGO AREA.. |__|__|__|

IF 0, SKIP TO ER3D.

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

   Which (airplane/helicopter) experienced smoke, fire or fumes in the cargo or baggage area? Was it (READ A10 MAKE/MODEL LIST)?

   SPECIFY MAKE/MODEL:

2. (Of the [# in ER3C] times there was smoke, fire, or fumes in the cargo area, how many involved/Did the smoke, fire, or fumes in the cargo area involve) electrical components or wiring?

   CARGO SMOKE/FIRE/FUMES .... |__|__|__|

   THE AMOUNT IN ER3C1 CANNOT BE GREATER THAN THE AMOUNT IN ER3C.

D. REPEAT INTRODUCTION: the passenger compartment area?

IN ELECTRICAL PASSENGER AREA .... |__|__|__|

IF 0, SKIP TO ER3E.

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

   Which (airplane/helicopter) experienced smoke, fire or fumes in the passenger compartment area? Was it (READ A10 MAKE/MODEL LIST)?

   SPECIFY MAKE/MODEL:

2. (Of the [# in ER3D] times there was smoke, fire, or fumes in the passenger compartment, how many involved/Did the smoke, fire, or fumes elsewhere in the passenger compartment involve) electrical components or wiring?

   SMOKE/FIRE/FUMES .... |__|__|__|

   THE AMOUNT IN ER3D1 CANNOT BE GREATER THAN THE AMOUNT IN ER3D.

E. How many times (an airplane/a helicopter) experience smoke, fire or fumes that originated someplace other than in the engine or nacelle, cockpit, cargo area, or passenger area?

ORIGINATE OTHER PLACES............................. |__|__|__|

IF 0, SKIP TO ER4.

1. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

   Which (airplane/helicopter) experienced smoke, fire or fumes originating elsewhere? Was it (READ A10 MAKE/MODEL LIST)?

   SPECIFY MAKE/MODEL:

2. Where did the smoke, fire or fumes originate? SPECIFY.

   SPECIFY: ____

ER4.	During the last 60 days, how many times did an inflight (airplane/helicopter) on which you were a pilot or copilot experience a precautionary engine shutdown?	# PRECAUTIONARY ENGINE SHUTDOWNS............ |___|___|___| **IF 0, SKIP TO ER5.**
	A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10. Which (airplane/helicopter) experienced a precautionary engine shutdown? Was it (READ A10 MAKE/MODEL LIST)?	SPECIFY MAKE/MODEL:
ER5.	Experience a total engine failure?	# TOTAL ENGINE FAILURE...................................... |___|___|___| **IF 0, SKIP TO ER6.**
	A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10. Which (airplane/helicopter) experienced a total engine failure? Was it (READ A10 MAKE/MODEL LIST)?	SPECIFY MAKE/MODEL:
ER6.	Experience total loss of electrical power?	# TOTAL ELECTRICAL FAILURE .... |___|___|___| **IF 0, SKIP TO ER7.**
	A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10. Which (airplane/helicopter) experienced a total loss of electrical power? Was it (READ A10 MAKE/MODEL LIST)?	SPECIFY MAKE/MODEL:
ER7.	During the last 60 days when you were pilot or copilot, how many times did you discover that your (airplane/helicopter) had incorrect or bogus parts installed?	# TOTAL PARTS... |___|___|___| **IF 0, SKIP TO ER8.**
	A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10. Which (airplane/helicopter) had incorrect or bogus parts installed? Was it (READ A10 MAKE/MODEL LIST)?	SPECIFY MAKE/MODEL:

ER8. Have cabin doors, baggage doors or cowlings open inadvertently during flight ?

TOTAL DOORS OPEN .... |__|__|__|
IF 0, SKIP TO ER9.

A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which (airplane/helicopter) had doors or cowlings open inadvertently during flight? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

ER9. Have a door or window come off of the aircraft while in flight?

TOTAL DOORS OFF .... |__|__|__|
IF 0, SKIP TO ER10.

A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which (airplane/helicopter) had doors or windows come off the (airplane/ helicopter) while in flight? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

ER10. Experience a cargo shift or cargo coming loose?

TOTAL CARGO LOOSE .... |__|__|__|
IF 0, SKIP TO ER11.

A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which (airplane/helicopter) experienced a cargo shift or cargo coming loose? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

ER11. During the last 60 days, how many times did an (airplane/helicopter) on which you were a pilot or copilot fly or attempt to fly with fuel contaminated by water?

TOTAL CONTAMINATED FUEL .... |__|__|__|
IF 0, SKIP TO ER12.

A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which (airplane/helicopter) had water-contaminated fuel? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

ER12. Fly or attempt to fly with the wrong type of fuel?

TOTAL WRONG FUEL .... |__|__|__|

IF 0, SKIP TO ER13.

A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which (airplane/helicopter) flew or attempted to fly with the wrong type of fuel? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

ER13. Experience a failure of the attitude indicator or artificial horizon?

TOTAL ATTITUDE INDICATOR .... |__|__|__|

IF 0, SKIP TO ER14.

A. ASK ONLY IF MORE THAN ONE MAKE/MODEL IN A10.

Which (airplane/helicopter) experienced this failure? Was it (READ A10 MAKE/MODEL LIST)?

SPECIFY MAKE/MODEL:

B. (Of the [# in ER13] times the attitude indicator failed, how many occurred/Did this failure of the attitude indicator occur) in instrument meteorological conditions or I.M.C? I.M.C means the visibility was less than three miles and/or the ceiling was less than 1,000 feet above ground.

TOTAL ATTITUDE INDICATOR IN IMC.................. |__|__|__|

INTRODUCTION:

My next questions relate to **turbulence**.

TU1. During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or copilot encounter severe turbulence that caused large abrupt changes in altitude, airspeed, or attitude

CAUSED ABRUPT CHANGES................................ |__|__|__|

IF 0, SKIP TO TU2.

A. (Of the [#in TU1] severe turbulence encounters, how many occurred/Did this severe turbulence encounter occur) in I.M.C. conditions? [Note to interviewer: I.M.C. = INSTRUMENT METEOROLOGICAL CONDITIONS]

IN IMC CONDITIONS .... |__|__|__|

THE AMOUNT IN TU1A CANNOT BE GREATER THAN THE AMOUNT IN TU1.

B. (Of the [# in TU1] severe turbulence encounters, how many occurred/Did this severe turbulence encounter occur) in clear air?

IN CLEAR AIR.. |_|_|_|

THE AMOUNT IN TU1A AND TU1B CANNOT BE GREATER THAN THE AMOUNT IN TU1.

C. (Of the [# in TU1] severe turbulence encounters, how many resulted in one or more occupants being injured.

INJURY EVENTS.. |_|_|_|

TU2. Encounter wake turbulence that resulted in 45 or more degrees of aircraft roll

RESULTING IN AIRCRAFT ROLL........................... |_|_|_|

INTRODUCTION:

My next questions are about **weather-related events while airborne**.

WE1. During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or copilot lack accurate weather information when you needed it while airborne?

LACK WEATHER INFORMATION .... |_|_|_|

IF 0, SKIP TO WE2.

A. (Of the [# WE1] times when you lacked accurate weather information, how many involved non-U.S. airports or controllers? Did this time when you lacked accurate weather information involve a non-U.S. airport or controller?)

INVOLVE NON-US AIRPORT OR CONTROLLER ... |_|_|_|

THE AMOUNT IN WE1A CANNOT BE GREATER THAN THE AMOUNT IN WE1.

B. (Of the [# WE1] times when you lacked accurate weather information, how many involved ATIS? Did this time when you lacked accurate weather information involve ATIS?)

INVOLVE ATIS.. |_|_|_|

THE AMOUNT IN WE1B CANNOT BE GREATER THAN THE AMOUNT IN WE1.

C. (Of the [# WE1] times when you lacked accurate weather information; how many involved Flight Service Stations (FSS)? Did this time when you lacked accurate weather information involve a Flight Service Station (FSS?)

INVOLVE FSS... |_|_|_|

THE AMOUNT IN WE1C CANNOT BE GREATER THAN THE AMOUNT IN WE1.

D. (Of the [# WE1] times when you lacked accurate weather information, how many involved Flight Watch? Did this time when you lacked accurate weather information involve Flight Watch?)

INVOLVE FLIGHT WATCH .... |_|_|_|

THE AMOUNT IN WE1D CANNOT BE GREATER THAN THE AMOUNT IN WE1.

E. (Of the [# WE1] times when you lacked accurate weather information, how many involved the Automatic Weather Observation Service (AWOS) or Automatic Surface Observation Service (ASOS)? Did this time when you lacked accurate weather information involve the Automatic Weather Observation Service (AWOS) or Automatic Surface Observation Service (ASOS)?)

INVOLVE AWOS .... |__|__|__|

THE AMOUNT IN WE1E CANNOT BE GREATER THAN THE AMOUNT IN WE1.

WE2-A. AIRPLANE ONLY.
How many times did an airplane divert to an alternate airfield because of weather?

DIVERT TO ALTERNATE AIRFIELD .... |__|__|__|
AIRPLANE GO TO WE3-A.

WE2-H HELICOPTER ONLY.
How many times did a helicopter divert to an alternate airfield, heliport or land because of weather?

DIVERT TO ALTERNATE AIRFIELD .... |__|__|__|
HELICOPTER GO TO WE3-H.

WE3-A AIRPLANE ONLY.
How many times did an airplane experience airframe icing that reduced the aircraft's ability to maintain altitude, speed, stability, or directional control?

EXPERIENCE AIRFRAME ICING .... |__|__|__|

WE3-H HELICOPTER ONLY.
How many times did a helicopter experience airframe or rotor icing that reduced the aircraft's ability to maintain altitude, speed, stability, or directional control?

EXPERIENCE AIRFRAME ICING .... |__|__|__|

WE4. During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or copilot encounter windshear or a microburst condition that resulted in an airspeed deviation of 15 knots or greater?

ENCOUNTER WINDSHEAR/MICROBURST .... |__|__|__|
AIRCRAFT SKIP TO CP1. HELICOPTER CONTINUE.

WE5-H HELICOPTER ONLY.
How many times did a helicopter experience loss of tail rotor effectiveness due to high density altitude?

ROTOR EFFECTIVENESS ALT .... |__|__|__|

WE6-H HELICOPTER ONLY.
How many times did a helicopter experience loss of tail rotor effectiveness due to high winds?

ROTOR EFFECTIVENESS WINDS .... |__|__|__|

WE7-H HELICOPTER ONLY.
How many times did a helicopter experience loss of the visible horizon due to white out or brown out conditions on either takeoff or landing?

INVOLVE NON-US AIRPORT OR CONTROLLER ... |__|__|__|

INTRODUCTION:

My next question is about **passenger-related events.**.

CP1. During the last 60 days, how many times were you distracted by a passenger while in flight through conversation or physical contact?

NOTE TO INTERVIEWERS: INCLUDES TAPPING ON SHOULDER.

PAX DISTRACT .... |__|__|__|

INTRODUCTION:

My next questions are about **airborne conflicts.** Just as a reminder, we are only asking about events that you experienced flying under FAR Part 135 or Part 91 as (an airplane/a helicopter) pilot or copilot.

How many times did (an airplane/a helicopter) (READ QUESTION)?

AC1. Experience a bird strike?

BIRD STRIKES.. |__|__|__|

AC2. Perform an evasive action to avoid an imminent in-flight collision with another aircraft that was never closer than 500 feet?

EVASIVE ACTIONS .... |__|__|__|

AC3. Experience less than 500 feet of separation from another aircraft while both aircraft were airborne?

LESS THAN 500 FEET SEPARATION..................... |__|__|__|

INTRODUCTION:

The next few questions are about **ground operations**.

GE1. During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or copilot Land at a location without a wind sock, wind vane, or other wind indicator device?

WIND INDICATOR.. |__|__|__|

GE2.	Take off, or attempt to take off, with control locks, pitot covers, or other protective gear still attached to the aircraft? NOTE TO INTERVIEWER: INCLUDES BUT NOT LIMITED TO: GEAR FLAGS; ENGINE, INTAKE, OR EXHAUST PLUGS; TIE-DOWNS.	# PROTECTIVE GEAR... |__|__|__|
GE3.	Experience an unplanned aborted or rejected takeoff?	# REJECTED TAKEOFFS... |__|__|__| HELICOPTER SKIP TO GE8. AIRPLANE CONTINUE.
GE4-A.	AIRPLANE ONLY. During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or copilot go off the edge of a runway or taxiway while taxiing?	# GO OFF EDGE RUNWAY/TAXIWAY....................... |__|__|__|
GE5-A.	AIRPLANE ONLY. Go off the **edge** of a runway while taking off or landing?	# GO OFF EDGE OF RUNWAY .... |__|__|__|
GE6-A.	AIRPLANE ONLY. Go off the **end** of the runway?	# GO OFF END OF RUNWAY..................................... |__|__|__|
GE7-A.	AIRPLANE ONLY During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or copilot inadvertently enter an active runway?	# ENTER ACTIVE RUNWAY .... |__|__|__|
GE8-A	AIRPLANE ONLY Begin takeoff while another aircraft occupied or was crossing the same runway?	# TAKEOFF ROLL WITH OCCUPIED RUNWAY......... |__|__|__|
GE9-A	AIRPLANE ONLY Land while another aircraft occupied or was crossing the same runway?	# LAND ON OCCUPIED RUNWAY…………………….. |__|__|__| HELICOPTER SKIP TO GE11. AIRPLANE CONTINUE.
GE10-A.	AIRPLANE ONLY. Hit or collide with a runway or taxiway light?	# HIT LIGHTS... |__|__|__|
GE11.	During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or copilot hit a deer or other animal other than a bird?	# HIT ANIMAL .... |__|__|__| HELICOPTER SKIP TO GE13. AIRPLANE CONTINUE.

GE12-A. AIRPLANE ONLY.
Collide or nearly collide with a ground vehicle?

COLLIDE WITH GROUND VEHICLE .... |__|__|__|

IF 0, SKIP TO GE14.

A. (Of the [# in GE12] near collisions with a ground vehicle, how many occurred/Did this near collision with a ground vehicle occur) while your aircraft was on the ramp or apron?

ON RAMP/APRON/GATE AREA .... |__|__|__|

THE AMOUNT IN GE12A CANNOT BE GREATER THAN THE AMOUNT IN GE12.

B. (Of the [# in GE12] near collisions with a ground vehicle, how many occurred/Did this near collision with a ground vehicle occur) while your aircraft was on the taxiway?

ON TAXIWAY .... |__|__|__|

THE AMOUNT IN GE12A AND GE12B COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE12.

C. (Of the [# in GE12] near collisions with a ground vehicle, how many occurred/Did this near collision with a ground vehicle occur) while your aircraft was on the runway?

ON RUNWAY .... |__|__|__|

THE AMOUNT IN GE12A, GE12B, AND GE12C COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE12.

SKIP TO GE14.

GE13-H. HELICOPTER ONLY.
Collide or nearly collide with a ground vehicle?

COLLIDE WITH GROUND VEHICLE .... |__|__|__|

.... IF 0, SKIP TO GE15.

A. (Of the [# in GE13] near collisions with a ground vehicle, how many occurred/Did this near collision with a ground vehicle occur) while your aircraft was operating at an airport, **not** a heliport?

AT AIRPORT .... |__|__|__|

THE AMOUNT IN GE13A CANNOT BE GREATER THAN THE AMOUNT IN GE13.

B. (Of the [# in GE13] near collisions with a ground vehicle, how many occurred/Did this near collision with a ground vehicle occur) while your aircraft was operating at a heliport? NOTE TO INTERVIEWER, NOT AT AN AIRPORT.

AT HELIPORT .... |__|__|__|

THE AMOUNT IN GE13A AND GE13B COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE13.

C. (Of the [# in GE13] near collisions with a ground vehicle, how many occurred/Did this near collision with a ground vehicle occur) while your aircraft was operating at an unprepared landing site?

UNPREPARED SITE .... |__|__|__|

THE AMOUNT IN GE13A, GE13B, AND GE13C COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE13.

SKIP TO GE15.

GE14-A. AIRPLANE ONLY.
During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or copilot nearly experience a ground collision with another aircraft while both aircraft were on the ground?

NEAR GROUND COLLISION .... |__|__|__|
.... IF 0, SKIP TO GE15.

A. (Of the [# in GE14] near collisions with another aircraft, how many occurred/Did this near collision with another aircraft occur) while your aircraft was on the ramp or apron?

ON RAMP/APRON/GATE AREA .... |__|__|__|
THE AMOUNT IN GE14A CANNOT BE GREATER THAN THE AMOUNT IN GE14.

B. (Of the [# in GE14] near collisions with another aircraft, how many occurred/Did this near collision with another aircraft occur) while your aircraft was on the taxiway?

ON TAXIWAY .... |__|__|__|
THE AMOUNT IN GE14A AND GE14B COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE14.

C. (Of the [# in GE14] near collisions with another aircraft, how many occurred/Did this near collision with another aircraft occur) while your aircraft was on the runway?

ON RUNWAY .... |__|__|__|
THE AMOUNT IN GE14A, GE14B, AND GE14C COMBINED CANNOT BE GREATER THAN THE AMOUNT IN GE14.

GE15. During the last 60 days, how many times did you experience a collision or near collision with anything other than an animal, a ground vehicle, or another aircraft while on the ground?

OTHER GROUND COLLISION .... |__|__|__|
....IF 0, SKIP TO AH1.

A. What were the objects you collided with or nearly collided with?

SPECIFY: ____

INTRODUCTION:

My next questions are about **aircraft handling-related events.**

AH1. During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or co-pilot use some of its reserve fuel as defined by the FARs (Federal Aviation Regulations)?

USE RESERVE FUEL .... |__|__|__|

AH2. Accept an A.T.C. clearance that the (airplane/ helicopter) could not comply with because of its performance limits?

ACCEPT CLEARANCE NOT COMPLY WITH........... |__|__|__|

AH3.	Lose sight of another aircraft from which the pilot or copilot was trying to maintain visual separation?	# LOSE SIGHT OF AIRCRAFT.................................... |__|__|__| **IF 0, SKIP TO AH4.**
	A. (Of the [# in AH3] times an aircraft lost sight of another aircraft, how many occurred/Did losing sight of another aircraft occur) in marginal visual conditions of 3 miles or less?	# IN MARGINAL VISUAL CONDITONS .... |__|__|__| ***THE AMOUNT IN AH3A CANNOT BE GREATER THAN THE AMOUNT IN AH3.***
AH4.	Inadvertently land without clearance at an airport with an active control tower	# LAND W/O CLEARANCE... |__|__|__|
	As a reminder, these questions still refer to the last 60 days. During the last 60 days, how many times did an aircraft on which you were a pilot or co-pilot (READ QUESTION)?	
AH5.	During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or co-pilot inadvertently begin takeoff without A.T.C. (air traffic control) clearance at an airport with an active control tower?	# TAKEOFF ROLL W/O CLEARANCE .... |__|__|__|
AH6	Inadvertently deviate from an assigned routing or A.T.C. vector for one minute or more?	# DEVIATIONS... |__|__|__|
AH7.	Take off with an out-of-limit center of gravity?	# TAKE-OFF OUT-OF-LIMIT CENTER OF GRAVITY . |__|__|__|
AH8.	Take-off overweight?	# TAKE-OFF OVERWEIGHT .... |__|__|__| HELICOPTER SKIP TO AH10. AIRPLANE CONTINUE.
AH9-A.	AIRPLANE ONLY. Commence take-off roll with an improper aircraft configuration?	# WITH IMPROPER CONFIGURATION..................... |__|__|__|
AH10.	During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or co-pilot experience an unintended unusual attitude for any reason?	# UNUSUAL ATTITUDE.. |__|__|__| AIRPLANE SKIPTO AH11. HELICOPTER CONTINUE.
	As a reminder, these questions still refer to the last 60 days. During the last 60 days, how many times did an aircraft on which you were a pilot or co-pilot (READ QUESTION)?	
AH11-H	HELICOPTER ONLY. Experience a valid low rotor R.P.M warning for any reason?	# LOW RPM WARNING.. |__|__|__| HELICOPTER SKIP TO AH12. AIRPLANE CONTINUE.

AH11-A AIRPLANE ONLY.
Experience an unintentional stall or valid stall warning?

STALL WARNING/STICK SHAKER ACTIVATION ... |__|__|__|

AH12. Nearly collide with terrain or ground obstruction or wires while airborne?

NEAR COLLISIONS/GROUND .... |__|__|__|
IF 0, AIRPLANE SKIP TO AH13, HELICOPTER SKIP TO A14.

INTERVIEWER NOTE: INCLUDES BUILDINGS

A. (Of the [# in AH12] near collisions with terrain, ground obstruction or wires, how many were/Was this near collision with terrain, ground obstruction or wires)-brought to your attention by A.T.C.(Air Traffic Control)?

ATC BROUGHT TO YOUR ATTENTION .... |__|__|

THE AMOUNT IN AH12A CANNOT BE GREATER THAN THE AMOUNT IN AH12.

B. (Of the [# in AH12] near collisions with terrain, ground obstruction or wires, how many were/Was this near collision with terrain, ground obstruction or wires) detected through direct sighting of the ground or obstruction?

DETECTED THROUGH DIRECT SIGHTING .... |__|__|

THE AMOUNT IN AH12A AND AH12B COMBINED CANNOT BE GREATER THAN THE AMOUNT IN AH12.

C. (Of the [# in AH12] near collisions with terrain, ground obstruction or wires, how many involved just wires?

AH13-A AIRPLANE ONLY.
Inadvertently cross the runway threshold during the landing approach with the landing gear up?

CROSS WITH GEAR UP .... |__|__|

A. (Of the [# in AH13] times an aircraft crossed the runway threshold with the landing gear up, how many times/The time the aircraft crossed the runway threshold with the landing gear up,) did you land with the gear up?

LAND WITH GEAR UP.. |__|__|

AH14. During the last 60 days, how many times did (an airplane/a helicopter) on which you were a pilot or co-pilot inadvertently enter airspace the aircraft was not cleared for?

UNCLEARED AIRSPACE .... |__|__|

As a reminder, these questions still refer to the last 60 days. During the last 60 days, (READ QUESTION)?

AH15. How many times did you lose track of the natural horizon due to reduced visibility while flying under Visual Flight Rules (V.F.R)?

LOSE HORIZON .... |__|__|

INTRODUCTION:

The next few questions are about **altitude deviations**.

AD1. How many times during the last 60 days did (an airplane/a helicopter) on which you were a pilot or copilot **inadvertently** deviate from an altitude assigned by A.T.C by more than 300 feet?

ALTITUDE DEVIATIONS.. |__|__|__|

AD2. ASK ONLY IF A12 > 0. OTHERS SKIP TO AT1. Earlier, you indicated you flew A12 flights. How many times during these A12 IFR flights) did you descend below Minimum Safe Altitude when you were **not** following A.T.C. radar vectors?

NOT FOLLOWING ATC RADAR VECTORS............ |__|__|__|

INTRODUCTIONS:

The next few questions are about **interactions with air traffic control**.

AT1. During the last 60 days, how many times was (an airplane/helicopter) on which you were a pilot or copilot unable to communicate with A.T.C. in a time-critical situation because of frequency congestion?

UNABLE TO COMMUNICATE WITH ATC .... |__|__|__|

IF 0, SKIP TO AT2.

A. (Of these [# in AT1] times you were unable to communicate with A.T.C. in a time-critical situation because of frequency congestion, how many occurred/Did the time you were unable to communicate with A.T.C in a time critical situation because of frequency congestion occur) **while on the ground**?

WHILE ON GROUND .... |__|__|__|
TIMES

THE AMOUNT IN AT1A CANNOT BE GREATER THAN THE AMOUNT IN AT1.

B. (Of these [# in AT1] times you were unable to communicate with A.T.C. in a time-critical situation because of frequency congestion, how many occurred/Did the time you were unable to communicate with A.T.C in a time critical situation because of frequency congestion occur) **while airborne in the terminal area**?

WHILE AIRBORNE.. |__|__|__|
TIMES

THE COMBINED TOTALS IN AT1A AND AT1B CANNOT BE GREATER THAN 100.

C. (Of these [# in AT1] times you were unable to communicate with A.T.C. in a time-critical situation because of frequency congestion, how many occurred/Did the time you were unable to communicate with A.T.C in a time critical situation because of frequency congestion occur) **while en route**?

WHILE EN ROUTE .... |__|__|__|
TIMES

THE COMBINED TOTALS IN AT1A, AT1B, AND AT1C CANNOT BE GREATER THAN 100.

AT2. How many times did (an airplane/a helicopter) fly at an undesirably high altitude or airspeed on approach due to an A.T.C. clearance
(NOTE TO INTERVIEWERS: THIS INCLUDES BUT MAY NOT BE LIMITED TO "SLAM DUNK" APPROACHES.)

HIGH ALTITUDE OR AIRSPEED .... |__|__|__|

AT3. How many times did (an airplane/a helicopter) leave a communications frequency with A.T.C to get a weather briefing?

LEAVE FREQ FOR WEATHER .... |__|__|__|

AT4. How many times during the last 60 days were you informed that (an airplane/a helicopter) on which you were a pilot or copilot missed a transmission from A.T.C?

MISS TRANSMISSION .... |__|__|__|

A. Of the [# in AT4] times you missed a transmission from ATC, how many occurred/Did the time you missed a transmission from A.T.C occur due to being on the wrong frequency?

WRONG FREQUENCY .... |__|__|__|

B. Of the [# in AT4] times you missed a transmission from ATC, how many occurred/Did the time you missed a transmission from A.T.C occur due to high cockpit noise?

COCKPIT NOISE |__|__|__|

1) Were you wearing a communication headset at the time? (Note to interviewers: This includes helmets with integral headset speakers)

HEADSET .... |__|__|__|

AT5. How many times did you receive out of date, inaccurate or no information about relevant NOTAMs?

NOTE TO INTERVIEWERS: NOTAMS = "NOTICES TO AIRMEN"

NOTAMS.. |__|__|__|

General Aviation Questionnaire

Section C:
Weather-related Issues

SECTION C: WEATHER-RELATED ISSUES

INTRODUCTION:

The next set of questions is a special focused topic section of the survey regarding weather-related issues. The first set of questions asks about **weather planning for your flights.** Just as a reminder, we are still only asking about events that you experienced flying under FAR Part 135 or Part 91 as (an airplane/a helicopter) pilot or copilot. Again, we use the terms "flight" throughout this interview to mean the period of time between each takeoff and landing, even if that time is short such as for instructors teaching students to land.

THE FOLLOWING QUESTIONS ARE FOR ALL PILOTS

C1. Earlier in the interview, you indicated you made [# TAKEOFFS IN A5a+A6a for airplane or a5b and a6b for helicopter] takeoffs in (an airplane/a helicopter) during the past 60 days. (For how many of these flights did you obtain pre-flight weather information? /On this flight, did you obtain pre-flight weather information?)

FLIGHTS WEATHER BRIEFING .... |__|__|__|

IF 0, SKIP TO C4.

A. (Of these [# FLIGHTS C1] flights where you obtained preflight weather information, how many were obtained by/Was the preflight weather information obtained by) (READ QUESTIONS):

1. **Commercial TV, radio, or cable weather broadcast** that was **not specific to aviation**?

   # COMMERCIAL NON-AVIATION .... |__|__|__|
   CANNOT BE GREATER THAN C1.

2. **Commercial TV, radio, or cable weather broadcast** that was **specific to aviation?**

   # COMMERCIAL AVIATION .... |__|__|__|
   CANNOT BE GREATER THAN C1

3. **Company provided weather from a dispatcher**?

   # COMPANY…………………………………………… |__|__|__|
   CANNOT BE GREATER THAN C1

4. **DUATS or other computer-accessed aviation weather service**?

   DUATS = computer-based weather service provided by the F.A.A.

   # COMPUTER ACCESS .... |__|__|__|
   CANNOT BE GREATER THAN C1

5. **Pre-recorded Flight Service Station Weather Brief**?

   Flight Service Station = F.S.S.

   # PRE-RECORDED .... |__|__|__|
   CANNOT BE GREATER THAN C1

6. **Verbal briefing with an FAA flight service station specialist** (F.S.S)?

   # VERBAL BRIEFING .... |__|__|__|
   CANNOT BE GREATER THAN C1

7. Did you obtain pre-flight weather information in some other way?

YES 1
NO .... (SKIP TO C2)....................................0
RF..................................... (SKIP TO C2)....................................7
DK..................................... (SKIP TO C2)....................................8

a. How did you obtain the weather information?

SPECIFY:

C2. IF ONLY ONE QUESTION ANSWERED IN C1A1-7, SKIP TO C2A.

You said you used the following pre flight weather information sources in the last 60 days (LIST ITEMS CODED ONE OR HIGHER IN C1A1-7. Which did you use most recently?

COMMERCIAL NOT SPECIFIC TO AVAITION

COMMERCIAL SPECIFIC TO AVIATION

COMPANY PROVIDED

DUATS OR OTHER COMPUTER ACCESSED

PRE-RECORDED FLIGHT SERVICE STATION

VERBAL FAA BREIFING

OTHER

RF

DK

A. How understandable was the weather information you received most recently from (SOURCE LISTED IN C2)? Would you say it was [READ OPTIONS]?

Not at all understandable...1
Slightly understandable 2
Moderately understandable 3
Very understandable 4
Extremely understandable........... 5
RF.. 7
DK... 8

.

B. How accurate was that weather information you received most recently from (SOURCE LISTED IN C2) in relation to the weather conditions you encountered during flight? Would you say the information was [READ OPTIONS]?

Not at all accurate..1
Slightly accurate 2
Moderately accurate..................... 3
Very accurate 4
Extremely accurate...................... 5
RF.. 7
DK... 8

C. How much time elapsed between your most recent weather briefing and the time of takeoff?

HOURS ....|__|__|__|

MINUTES... ....|__|__|__|

C3 In which state or states do you primarily fly?

INTERVIEWER: RECORD UP TO 3 STATES USING 2-DIGIT STATE CODE LISTED BELOW. IF PILOT GIVES OTHER TYPE OF ANSWER (E.G., “NORTHEAST,” RECORD.

STATE 1:

STATE 2:

STATE 3:

OTHER (RECORD)

C4. As a reminder, we are still only asking about events that you experienced flying under FAR Part 135 or Part 91 as (an airplane/a helicopter) pilot or copilot (Of the [# in A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER] takeoffs you made during the last 60 days, how many of these flights were/Was the takeoff you made during the last 60 days) conducted under V.F.R flight rules?

TAKEOFFS UNDER VFR.. |__|__|__|

CANNOT BE GREATER THAN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER

VFR = Visual Flight Rules: Visibility greater than 3 miles and ceiling greater than 1,000 feet above ground level

C5. Do you, or your organization, apply pre-flight **V.F.R** weather minimums that are more conservative than those required by the F.A.A?

YES 1
NO .... (SKIP TO C6)....................................0
RF..................................... (SKIP TO C6)....................................7
DK..................................... (SKIP TO C6)....................................8

INTERVIEWER: IF PILOT MENTIONS IFR HERE, LET HIM/HER KNOW WILL BE GETTING TO IFR LATER IN THE INTERVIEW.

A. Under those more conservative weather minimums, what is the minimum number of **miles of visibility** you or your organization require?

MILES VFR MIN VISIBILITY .... |__|__|__|

B. Under those more conservative weather minimums, what is the minimum **ceiling in feet** that you or your organization require?

FEET VFR MIN CEILING .... |__|__|__|

INTRODUCTION: My next questions are about the weather related issues **during** the flights.

C6. Earlier in the interview, you indicated you made [# TAKEOFFS IN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER] takeoffs as (an airplane/a helicopter) pilot or copilot during the past 60 days. (On how many of these flights/On that flight) did poor weather result in you loosing track of your position?

LOST DUE TO WEATHER .... ………………………... |__|__|__|

CANNOT BE GREATER THAN A5+A6

IF 0, SKIP TO C7.

A. (For that time/For the most recent time that happened), what was the visibility in miles?

VISIBILITY IN MILES ………………………………….. |__|__|__|

NEED TO ADD DECIMAL

C7. (In how many of the [# TAKEOFFS IN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER] flights did you experience spatial disorientation from poor visibility due to weather?/On the one flight you made during the last 60 days, did you experience spatial disorientation from poor visibility due to weather?)

TIMES SPATIAL DISORIENTATION ……………… |__|__|__|

CANNOT BE GREATER THAN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER.

IF 0, SKIP TO C8.

	A. For (that/the most recent) event, what was the estimated visibility in miles?	VISIBILITY IN MILES ………………………………… |__|__|__| NEED TO ADD DECIMAL
	B. (How many occurred at night?/Did that flight occur at night?	# SPATIAL DISORIENTATION AT NIGHT……………… |__|__|__| **CANNOT BE GREATER THAN C7.**
C8	During the last 60 days, (on how many of the [# TAKEOFFS IN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER] flights) how many times did you inadvertently enter instrument meteorological conditions or I.M.C while on a VFR flight? IMC = Instrument meteorological conditions: Visibility less than 3 miles and/or cloud ceiling less than 1,000 feet above ground level VFR = Visual Flight Rules: Visibility greater than 3 miles and ceiling greater than 1,000 feet above ground level	# INADVERTENT IMC... |__|__|__| **CANNOT BE GREATER THAN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER.** **IF 0, SKIP TO C9.**
	A. (How many times did this/Did this) occur at night	# IMC AT NIGHT……………………………………… |__|__|__| **CANNOT BE GREATER THAN C8.**
	B. How did you resolve [that/the most recent] inadvertent I.M.C problem? Did you (READ ANSWERS)?	Ask for A.T.C help without declaring an emergency. Ask for A.T.C help and declare an emergency. Reverse course Climb Descend File IFR Do something else (RECORD)__________________________ RF DK
C9	(On how many of the [# TAKEOFFS IN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER] flights/On the one flight you conducted during the last 60 days) did weather conditions result in you conducting a go-around or missed approach on landing?	# GO AROUND .... |__|__|__| **CANNOT BE GREATER THAN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER.** **IF 0, SKIP TO C10.**
	A. How many were/Was this) due to due to poor visibility?	# GO AROUND VIS... |__|__|__| **CANNOT BE GREATER THAN C9.**
	B. How many were/Was this) due to high winds?	# GO AROUND WINDS .... |__|__|__| **CANNOT BE GREATER THAN C9.**
C10	(On how many of the [# TALKEOFFS IN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER] flights/On the one flight) you conducted during the last 60 days, how many times did worsening weather conditions result in you diverting to an alternative landing site?	# LAND DUE TO WEATHER .... |__|__|__|

A. On the most recent/On that) flight how did you determine that the weather was worsening? Did you (READ ANSWERS)?

RECEIVE AN UPDATED INFLIGHT WEATHER BRIEFING FROM A FLIGHT SERVICE STATION (ALL METHODS). OBSERVE THE WEATHER DIRECTLY FROM COCKPIT. OBTAIN PILOT REPORTS FROM OTHER PILOTS USING FLIGHT WATCH DO SOMETHING ELSE (RECORD) ____

The following questions are for VFR rated pilots only

(Determined from question A1=no)

All other skip to C15.

C11 My next questions are about instrument flying you may have conducted. Now I'm going to ask a few questions about instrument flying you may have conducted as (an airplane/a helicopter) pilot or copilot over the last 60 days.

(On how many of the [# TAKEOFFS IN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER] flights /On the one flight you conducted) did you find yourself flying V.F.R over a cloud deck sometimes called "V.F.R on top," where you had to penetrate the cloud deck in order to land?

VFR ON TOP..|__|__|__|

CANNOT BE GREATER THAN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER

VFR = Visual Flight Rules: Visibility greater than 3 miles and ceiling greater than 1,000 feet above ground level

A. On the most recent/On that) flight how did you get through the cloud deck to land? Did you (READ CATEGORIES)?

ASK FOR ATC HELP WITHOUT DECLARING AN EMERGENCY. ASK FOR ATC HELP AND DECLARED AN EMERGENCY. DESCENDED THROUGH THE CLOUDS WITHOUT CONTACTING ANYONE FILE IFR OR SOMETHING ELSE RECORD) _________________________

C12 How many hours of instrument training have you received since you began to fly?

HOURS OF INSTRUMENT TRAINING ....……….|__|__|__|

C13 How many hours of training have you received in actual I.M.C conditions (visibility less than three miles and/or ceiling less than 1,000 feet above ground level) since you began to fly?

HOURS OF ACTUAL INSTRUMENT TRAINING .....|__|__|__|

IMC = Instrument meteorological conditions: Visibility less than 3 miles and/or cloud ceiling less than 1,000 feet above ground level

C14 How long ago was your last instrument training session?

NOTE: THIS INCLUDES BIENNIAL FLIGHT REVIEWS

YEARS.. |__|__|__|

MONTHS.. |__|__|__|

DAYS.. |__|__|__|

The following questions are for IFR rated pilots only

(Determined from question A1=yes)
Other skip to D1

INTRODUCTION: My next questions are about instrument flying you may have conducted. Now I'm going to ask a few questions about instrument flying you may have conducted as (an airplane/a helicopter) pilot or copilot over the last 60 days.

C15 (On how many of the [# TAKEOFFS IN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER] flights/On the one flight) did you file an I.F.R flight plan?

IFR: = Instrument Flight Rules

IFR FLIGHT PLANS .... |__|__|__|

CANNOT BE GREATER THAN A5A+A6A FOR AIRPLANE OR A5B AND A6B FOR HELICOPTER
IF 0, SKIP TO C16.

A. Of these [# FLIGHTS IN C15] flights, how many had I.M.C conditions at least part of the time?/Did this flight have I.M.C conditions at least part of the time?)

#IMC CONDITIONS .... |__|__|__|

CANNOT BE GREATER THAN C15

IMC: = Instrument meteorological conditions: Visibility less than 3 miles and/or cloud ceiling less than 1,000 feet above ground level

C16 Do you, or your organization, apply pre-flight **I.F.R** weather minimums that are more **conservative** than that required by the F.A.A?

IFR= Instrument Flight Rules

YES 1
NO .... (SKIP TO C17)....................................0
RF.................................... (SKIP TO C17)....................................7
DK.................................... (SKIP TO C17)....................................8

A. Under those more conservative I.F.R weather minimums, what is the minimum number of **miles of visibility** you or your organization require?

IFR MILES VISIBILITY .... |__|__|__|

B. Under those conservative I.F.R weather minimums, what is the **minimum ceiling in feet y**ou require?

IFR IN FEET CEILING .... |__|__|__|

NOTE—MAY NEED MORE BLOCKS

C17 IF C15 IS 0, SKIP TO C18.

During the last flight you flew where you filed I.F.R, did the aircraft have (READ QUESTIONS)?

A. Weather radar or thunderstorm detection equipment?

YES 1
NO 0
RF 7
DK 8

B. Autopilot, including wing levelers?

YES 1
NO 0
RF 7
DK 8

AIRPLANES ONLY

C. Anti-icing equipment that is approved for flight in icing conditions?

YES 1
NO 0
RF 7
DK 8

C18 (On how many of the [# FLIGHTS IN C15] flights/On the one flight) you conducted during the last 60 days, did you fly an instrument approach to land in I.M.C.?

IMC = Instrument meteorological conditions: Visibility less than 3 miles and/or cloud ceiling less than 1,000 feet above ground level

INSTRUMENT LANDING IMC ....|__|__|__|

....................I

F 0, SKIP TO D1

CANNOT BE GREATER THAN C15

A. During the (last) flight where you flew an instrument approach to landing in I.M.C conditions, what type approach was flown?

ILS

VOR

RNAV

GPS

LDA

SDB

NDB

BACK COURSE ILS

OTHER________________________

B. During the (last) flight where you flew an instrument approach to landing in I.M.C conditions, what was the ceiling, in feet, during the approach?

CEILING INSTRUMENT LANDING....................|__|__|__|

DK

RF

C. During the last flight where you flew an instrument approach to landing in instrument meteorological conditions, what was the visibility during the approach in miles or RVR (NOTE: runway visual range)

VISIBILITY INSTRUMENT MILES ....|__|__|__|

RVR (RUNWAY VISUAL RANGE) IN FEET ………………… ... |__|__|__|

DK

RF

C19 Just as a reminder, we are only asking about events that you experienced flying under FAR Part 135 or Part 91 as (an airplane/ a helicopter) pilot or copilot.

You indicated that you made [# FLIGHTS C18] flights on which you conducted an instrument approach to landing in IMC during the last 60 days. (How many of these approaches were/Was this approach) conducted under FAR part 91?

INSTRUMENT PART 91 .... |_|_|_|

IF 0, SKIP TO D1

C20 As you may know, the F.A.A currently allows pilots flying under FAR Part 91 to conduct instrument approaches, but not landings, when the weather conditions at the instrument approach landing facility is below landing minimums.

A. Are you aware of these regulations?

YES/NO/RF/DK

B. You just indicated that you made [# FLIGHTS C19] instrument approach[es] in I.M.C and under FAR part 91 during the last 60 days. (How many of those times did you fly the/Did you fly that) approach with the reported weather conditions **below** the minimums for that approach as allowed by the F.A.A?

INSTRUMENT BELOW MIN .... |_|_|_|

DK

RF

C. (On the most recent/On that) approach did the airport have on-site weather reporting?

YES 1
NO 0
RF.. 7

DK...

D. (During how many of those approaches/ During the approach) was the weather above minimums when you landed?

INSTRUMENT BELOW MIN LAND........................... |_|_|_|

General Aviation Questionnaire

Section D:
Questionnaire Feedback

SECTION D: QUESTIONNAIRE FEEDBACK

INTRODUCTION:

I only have a couple more questions and these are about your reactions to the survey we have just done.

D1. How confident are you that you accurately counted all of the safety-related events that I asked you about? Would you say you were (READ QUESTIONS)?

Not confident at all	1
Slightly confident	2
Moderately confident	3
Very confident	4
Extremely confident	5
RF	7
DK	8

D2. Were any of the questions I asked confusing, poorly worded, or ambiguous?

YES		1
NO	(SKIP TO E3)	0
RF	(SKIP TO E3)	7
DK	(SKIP TO E3)	8

A. Could you please describe these question problems? RECORD VERBATIM. AT COMPLETION OF INTERVIEW, ENTER QUESTION NUMBER.

QUESTION NUMBER	RECORD VERBATIM

D3. Are there any safety problems happening within the national aviation system that I did not ask about but that you think may be worth asking about in further surveys?

YES		1
NO	(SKIP TO E4)	0
RF	(SKIP TO E4)	7
DK`	(SKIP TO E4)	8

A. What are these problems?

SPECIFY: ______________________________

D4. Do **you** use the internet at home?

YES	1
NO	0
RF	7
DK	8

D5. Do you have any other comments or suggestions about this survey? RECORD VERBATIM.

____

____

____

____

ENDINT Again, thank you very much for your time and your help with this survey. Your input will help the aviation industry a great deal to measure the level of safety in the aviation system and will be held in confidence.

QUESTIONNAIRE LENGTH: QUESTIONNAIRE LENGTH (MINUTES) |__|__|__|